

# NATURAL RESOURCES: WILDLIFE 3

## The Greater Yellowstone Ecosystem

An ecosystem is a place where plants, animals, and their physical environment interact. Plants grow by drawing energy from the sun and nutrients from soils or decaying matter. Animals eat plants and each other. When animals die, their decomposing carcasses cycle nutrients back onto the system. Within an ecosystem, all forms of life are inextricably linked in a self-sustaining process. Many call this a “web of life.” Pull a string on one end of that web, and you will find it attached to everything else.

An ecosystem can be as small as a pond or as large as the planet. The 18-million acre greater Yellowstone ecosystem is one of the largest, relatively intact temperate zone ecosystems left on earth. Situated in Wyoming, Montana, and Idaho, the greater Yellowstone ecosystem includes Yellowstone and Grand Teton national parks, portions of seven surrounding national forests, three national wildlife refuges, and state and private lands.

Most of the region surrounding the core ecosystem has been radically altered, with much of the historical flora and fauna eliminated. Greater Yellowstone, in contrast, still contains nearly all of the living organisms found in pre-Columbian times, though generally not in the same numbers.

At the heart of the ecosystem is Yellowstone National Park. The magnificence of Yellowstone cannot be overstated. Each of its separate parts—the geothermal features, the wildlife, the lakes, the Grand Canyon of the Yellowstone, and the petrified forest—could easily stand alone as a national park. That they are all at one place is testimony to greater Yellowstone’s abundant diversity and its natural wealth.

### ***Biological Diversity***

Biological diversity refers to the diversity of life in all its forms and at all levels, including diversity of species, landscape, habitats, and genes. It is one of the benchmarks that can be used to measure the health of an ecosystem. Biodiversity can be measured two ways. The “richness” of an ecosystem, or the number of different species, is one way. The other is “evenness” or abundance of each species. The diversity of plants and animals within the greater Yellowstone ecosystem is as great as that found anywhere in the lower 48 states. Some 60 mammals, 303 bird species, 17 fishes, and ten reptiles and amphibians live in or pass through the ecosystem. Some 12,000 insect species exist here, including 128 species of butterflies. There are more than 1,700 species of vascular plants.

The greater Yellowstone ecosystem is host to the largest elk herd in all of North America, one of only two remaining populations in the lower 48 states of the majestic grizzly bear, the only U.S. wintering ground for the rare trumpeter swan, and the largest herd of free-ranging bison in the country. Wolverine and cougar still roam the mountains here, bighorn sheep scramble among its cliffs, and bald eagles commonly grace the skies. The paucity of diverse vegetation is striking, however; more than 40 percent of greater Yellowstone is dominated by one tree species, lodgepole pine.

What is significant about the area’s biological diversity is the fact that all of greater Yellowstone’s natural diversity is still essentially intact. With the exception of the black-footed ferret, the region appears to retain its full historic complement of vertebrate wildlife species—something truly unique in the context of wildlands of the contiguous 48 states.

The extent of wildlife diversity is due in part to the different habitats found in the region, ranging from high alpine areas to sagebrush country, geothermal areas, forests, meadows, and myriad other habitat types. All of these are connected, including linkages provided by streams and rivers that course through the changing elevations.

Despite the size of the ecosystem, the biodiversity of greater Yellowstone is in jeopardy. Many of its plant and animal species are considered to be rare, threatened, endangered, or of special concern. This includes more than 135 plants, hundreds of invertebrates, at least six fish species, several species of amphibians, at least 20 bird species, and 18 species of mammals. The numbers are estimates because, even in this vital region, comprehensive inventories have not been completed. Carnivorous mammals represent more than half of the mammals in danger, including the grizzly

bear, wolverine, fisher, and lynx.

A serious threat to both biodiversity and to ecosystem processes is habitat modification beyond the levels of natural disturbance—modifications that fragment or break up habitats in such a way that populations of plants and animals become isolated from each other and cut off from processes necessary for survival.

### ***Cycles and Processes***

The foundation of any ecosystem is constructed of cycles and processes. They are the building blocks that facilitate the flow of energy and raw materials. In all ecosystems, living things absorb, transform and circulate energy and raw materials and release them again. These processes and cycles include photosynthesis, predation, decomposition, climate, and precipitation, among others.

The cycles and processes provide the connections within the ecosystem. Without them, the system would collapse. Geologic forces shape the landscape. Ground water flows to replenish geothermal system. Weather wears down rock and helps dictate the type of vegetation. Nutrients such as carbon and nitrogen cycle through the system.

Lifeforms are active at all levels, including lichens that break down rock into soils. Plants draw energy from the sun and cycle minerals such as carbon, sulfur, and nitrogen through the system. Herbivores, ranging from grasshoppers to elk, feed on the plants and, in turn, provide food for predators like coyotes and hawks. The unsung heroes of the ecosystem are the hundreds of species of bacteria, fungi, and other microorganisms that constantly work to decompose matter. They link all that dies with all that is alive.

The ecosystem is constantly changing and evolving. The very character of greater Yellowstone has been shaped by millions of years of natural disturbance, ranging from the periods of volcanism to insect infestations to fire. The processes and cycles keep the ecosystem in dynamic balance.

The burning of forest fires is one example of such an integral, dynamic process. Fires are the way the forest rejuvenates itself on a grand scale. Some species of plants survive the intense burning and resprout. The serotinous cones of lodgepole pines pop open in heat generated by fires, spreading millions of seeds on the forest floor. After fire sweeps through an area, mammals, birds and insects quickly take advantage of the newly created habitats. Fires recycle nutrients and create dead trees or snags that serve a number of ecological functions, such as the addition of organic matter to the soil when the trees decompose.

While biological diversity of greater Yellowstone is largely intact today, many species are threatened, mostly by geographic isolation created by encroaching development. The smaller and more isolated a population, the more likely extinction is in a given period. That so many of the species are now threatened or are otherwise in jeopardy demonstrates that people influence the system in very critical ways.

### ***Ecosystem Management***

Though still evolving, the concept of “ecosystem management” is gaining support among conservationists and resource managers worldwide. The foundation of the concept is that most protected parks and reserves represent fragments of much larger ecosystems. Effective protection can be achieved only if ecosystems are treated as a unit. Ecosystem management must be concerned with the whole, including preserving individual components and the relationships and linkages between them. Maintaining intact ecosystems is also the best way to preserve species. It is more efficient to protect and maintain healthy, functioning ecosystems than to initiate “emergency room” measures to yank threatened species from the brink of extinction.

In the last few years, a coalition of more than 170 organizations, institutions, and foundations based in Canada and the United States have worked together to ensure the long-term survival of wildlife in the Northern Rockies. This effort is called the Yellowstone to Yukon Conservation Initiative, or “Y2Y.” Because wide-ranging wildlife species, such as grizzly bears and wolves, need much more territory than any one park or preserve can provide, Y2Y seeks to build and maintain a life-sustaining system of core protected reserves and connecting wildlife corridors. This effort

extends from the greater Yellowstone ecosystem to the Yukon Highlands—a distance of 1,900 miles. Existing national, state, and provincial parks and wilderness areas will anchor the system while the creation of new protected areas will provide the additional cores and corridors needed to complete it.

Ecosystem management can result in protection of key components of an ecosystem, while permitting activities in other parts in such a manner that ecological integrity is not damaged. Human health and welfare depends directly on the services and goods provided by healthy ecosystems. When ecosystems are fragmented or degraded, these goods and services may be destroyed. When development exceeds levels that can be sustained over a long period of time, future economic activities are threatened. Methods are available for assessing the impact developments will have on an ecosystem. “Cumulative effects analysis” considers combined effects of all development in an area on a species and a system, rather than just one activity.

As an ecosystem, greater Yellowstone is defined by topographical and biological boundaries between the more than 25 federal, state, and local government entities that manage ecosystem lands in units drawn along political lines. The result is fragmented, inconsistent, and sometimes contradictory management of adjacent lands. The concept of the greater Yellowstone ecosystem is gaining support. The supervisors, superintendents, and regional officials for the two national parks and six of seven national forests in the ecosystem meet periodically as the Greater Yellowstone Coordinating Committee to discuss common issues and seek solutions. In 1987, the Committee published a report titled the “Aggregation of Park and Forest Service Management Plans,” which provided a snapshot of current resources and their uses in the ecosystem. While this document did not analyze resource management problems, since then a growing awareness of the various ecosystem threats has led to a more holistic view of decisions.

Greater Yellowstone is a rare and extraordinary place. And, unlike many other places, the opportunity to protect wildlands, restore some of the damage that has been done by the careless use of resources, and maintain healthy, sustainable economies is still possible here.

## Threatened and Endangered Species In Yellowstone

The list below names federally listed threatened or endangered species known to reside or occur in Yellowstone National Park.

### Endangered

- Gray wolf (*Canis lupus*)
- Whooping crane (*Grus americana*)

### Threatened

- Grizzly bear (*Ursus arctos horribilis*)
- Bald eagle (*Haliaeetus leucocephalus*)—the eagle was down listed from endangered to threatened in four of five regions, including the one containing Yellowstone, in July 1995.
- Lynx (*Felis lynx canadensis*)—listed in March 2000.

Note: The peregrine falcon (*Falco peregrinus*)—formerly endangered, was delisted in August 1999.

### Other Species of Concern

Category 1 species are candidates for listing on the federal list of threatened or endangered species.

- Mountain plover (*Charadrius montanus*)—Migrant
- Arctic grayling (*Thymallus arcticus*)—in 1994, listing was determined to be warranted but precluded at that time.

In August 1995, the U.S. Fish and Wildlife Service issued new policy indicating Category 2 species are no longer considered candidates for listing. The list below of formerly classified Category 2 species indicates species about which we lack good information. These species are not all confirmed to be in Yellowstone, but may occur or reside here.

- Wolverine (*Gulo gulo luscus*)
- Spotted bat (*Euderma maculatum*)
- Preble's shrew (*Sorex preblei*)—only one recorded specimen from Yellowstone
- Long-billed curlew (*Numenius americanus*)—Migrant
- Burrowing owl (*Athene cunicularia*)—Migrant
- Ferruginous hawk (*Buteo regalis*)—Migrant
- Trumpeter swan (*Cygnus buccinator*)
- Harlequin duck (*Histrionicus histrionicus*)
- Black tern (*Chlidonias niger*)—Occasional
- Loggerhead shrike (*Lanius ludovicianus*)—Migrant
- Northern Goshawk (*Accipiter gentilis*)
- Western boreal toad (*Bufo boreas boreas*)
- Spotted frog (*Rana pretiosa*)
- Ross' bentgrass (*Agrostis rossiae*)—Endemic to Yellowstone
- Yellowstone sand verbena (*Abronia ammophila*)

## Mammals of Yellowstone National Park

Yellowstone National Park is home to the largest concentrations of large and small mammals in the lower 48 states. While some species are rare or occasional visitors to the park, 60 different mammals are listed as present here. Seven species of ungulates are native to the park—elk, mule deer, bison, moose, bighorn sheep, pronghorn, and white-tailed deer. Non-native mountain goats appear to be colonizing the park.

Numerous carnivores roam the area, including grizzly and black bears. The grizzly is listed as “threatened” on the Endangered Species List, and it is estimated that a minimum of at least 200 grizzly bears live in the greater Yellowstone area. Black bears are common. The gray wolf was native to the Yellowstone area, but was eliminated in the 1930s. In 1995, it was restored to the ecosystem. Mountain lions, bobcats, coyotes, and red fox also live here. A wide variety of small mammals, from chipmunks to marmots to squirrels to weasels to voles and mice inhabit the park. Beaver live here, too, but they are rarely seen. Park regulations prohibit feeding any animal, and visitors must stay at least 100 yards away from a bear and at least 25 yards away from all other wildlife (often it is advisable to stay even farther away).

The list below includes the name, common habitat, and, where available, the most recent population estimates of mammals found in Yellowstone. Even though a species is listed as “common,” you are not assured of seeing that animal. A park site bulletin, “Mammals of Yellowstone National Park,” is available at visitor centers and lists popular viewing areas for many large mammals.

### Mammals of Yellowstone

<b>ORDER Carnivora</b>	<b>Habitat</b>	<b><i>Estimated Population</i></b>
<b><u>Family Ursidae</u></b>		
Black Bear	forests, meadows	500–600
Grizzly Bear	forests, meadows	350–400
<b><u>Family Canidae</u></b>		
Coyote	forests, meadows, grasslands	common
Gray Wolf	forests, meadows	115
Red Fox	meadows	occasional
<b><u>Family Felidae</u></b>		
Bobcat	forests, meadows	uncommon
Mountain Lion (cougar, puma)	mountains, rocky areas	18–24
Lynx	sub-alpine forests	rare, if present
<b><u>Family Procyonidae</u></b>		
Raccoon	rivers, cottonwoods	occasional
<b><u>Family Mustelidae</u></b>		
Badger	sagebrush	common
Fisher	forests	rare, if present
Marten	coniferous forests	common
Mink	riparian forests	occasional
River Otter	rivers, lakes, ponds	common
Striped Skunk	riparian to forest	occasional
Long-tailed Weasel	willows to spruce/fir forests	common
Short-tailed Weasel (ermine)	willows to spruce/fir forests	common
Wolverine	coniferous forests	rare
<b>ORDER Artiodactyla</b>		
<b><u>Family Cervidae</u></b>		
Elk (Wapiti)	meadows, forests	35,000
Moose	riparian, forests	300–500
Mule Deer	forests, grasslands, shrub lands	2,500
White-tailed Deer	forests, grasslands, shrub lands	occasional
<b><u>Family Bovidae</u></b>		

Bison	meadows, grasslands	2,200–2,500
Bighorn Sheep	alpine meadows, cliffs	150–225
Mountain Goat (non-native)	rocky slopes	rare
<b><u>Family Antilocapridae</u></b>		
Pronghorn	sagebrush, grasslands	200–250
<b>ORDER Chiroptera</b>		
<b><u>Family Vespertilionidae</u></b>		
Big Brown Bat	roost in cliffs, attics; feed around water	rare
Little Brown Bat	roost in cliffs, attics; feed around water	common
Long-eared Bat	roost in cliffs, attics; feed around water	common
Big-eared Bat	roost in cliffs, attics; feed around water	common
<b>ORDER Lagomorpha</b>		
<b><u>Family Leporidae</u></b>		
Snowshoe Hare	forests, willows	common
White-tailed Jackrabbit	sagebrush, grasslands	common
Desert Cottontail	shrub lands	common
Mountain Cottontail	shrub lands	common
<b><u>Family Ochotonidae</u></b>		
Pika	rocky slopes	common
<b>ORDER Insectivora</b>		
<b><u>Family Soricidae</u></b>		
Dusky Shrew	moist meadows, forests	common
Masked Shrew	moist meadows, forests	common
Water Shrew	moist meadows, forests	common
Preble's Shrew	moist meadows, forests	rare, if present
Dwarf Shrew	moist meadows, forests	rare
<b>ORDER Rodentia</b>		
<b><u>Family Castoridae</u></b>		
Beaver	ponds, streams	300–3501
<b><u>Family Sciuridae</u></b>		
Least Chipmunk	forests	common
Uinta Chipmunk	forests	common
Yellow Pine Chipmunk	forests	common
Yellow-bellied Marmot	rocky slopes	common
Golden-mantled Ground Squirrel	forests	common
Northern Flying Squirrel	forests	occasional
Red Squirrel	forests	common
Uinta Ground Squirrel	sagebrush, meadows	common
<b><u>Family Geomyidae</u></b>		
Northern Pocket Gopher	sagebrush, meadows, forests	common
<b><u>Family Cricetidae</u></b>		
Deer Mouse	grasslands	common
Western Jumping Mouse	riparian	occasional
Muskrat	streams, lakes, ponds	common
Heather Vole	sagebrush to forests	occasional
Long-tailed Vole	moist meadows	common
Meadow Vole	moist meadows	common
Montane Vole	moist meadows	common
Red-backed Vole	dense forests	common
Water Vole	riparian	occasional
Bushy-tailed Woodrat	rocky slopes	common
<b><u>Family Erethizontidae</u></b>		
Porcupine	forests, sagebrush, willows	occasional

As of March 2000 . . .

### **Number in Yellowstone**

- 11 packs
- 115 individuals

### **Where to see**

Lamar Valley at dawn and dusk.

### **Food**

- 90% of a wolf's diet consists of elk. Wolf packs on the northern range kill about 9 elk in a 30 day period in early winter and about 14 elk in a 30 day period in late winter.

### **Mortality**

- High pup mortality in 1999 was probably due, in part, to parvo virus.
- Approximately 75 wolves have died since they were reintroduced. A number of pups did not survive the first few weeks, some wolves were legally destroyed due to livestock predation, some died of natural causes, some were killed by motor vehicles, and some were shot illegally.

### **Other Info**

- The Defenders of Wildlife has spent \$54,450 to compensate ranchers for livestock lost to wolves from 1996–1999.
- Livestock predation by wolves since reintroduction: 100 sheep, 12 cattle

### **Current Management**

- See "Wolf Restoration" in Chapter 8.

Wolves are highly social animals and live in packs. Most packs number 2 to 8 animals, with the largest ever recorded being 36 (in areas of abundant wolves, about 25 percent of the packs will have more than 8 members). The pack is a highly evolved and complex social family, with leaders (the alpha male and alpha female) and subordinates, each having individual personality traits. Packs generally command territory that is marked by urine scenting and defended against intrusion by other wolves (individuals or packs). Wolves are carnivores and consume a wide variety of prey, large and small. However, the evolution of packs and their structure allows efficient hunting of large prey while still competing with coyotes (and, to a lesser extent, foxes) for smaller meals.

Male wolves generally average 95 to 100 pounds, measure 5 to 6-1/2 feet from nose to tail-tip (tails are 13 to 20 inches), and stand about 3 feet tall at the shoulder. Females are somewhat smaller. The largest wolf on record was an Alaskan male which weighed 175 pounds. Pups are born blind, deaf, furred, and weighing about a pound. While gray is the predominate color, wolves range in color from white to buff to brown to reddish to gray to black.

Wolves ranged widely throughout North America in pre-Columbian times. Worldwide, all wolves, except the red wolf (*Canis rufus*) of the southeastern United States, are the same species. Based upon certain observable differences, however, biologists differentiate wolves into subspecies. Formerly, scientists recognized as many as 24 subspecies of wolves as native to the continent; current thought suggests that 5 is probably a more correct number.

## **Wolves**

### Early Management of Wolves

In the 1800s, westward expansion brought settlers and their livestock into direct contact with native predator and prey species. Much of the wolves' prey base was destroyed as agriculture flourished. With its prey base removed, wolves began to prey on domestic stock, which resulted in humans removing wolves from most of their historic range. (Other predators such as bears, mountain lions, and coyotes were also killed to protect livestock and "more desirable" wildlife species, such as deer and elk.) By the early 1900s, wolves had been eliminated from the 48 states (except for northern Minnesota and Michigan's Isle Royale), even in places where there was no livestock, like Yellowstone.

Today, it is difficult for many to understand why early park managers would have participated in the extermination of wolves. After all, the Organic Act (1872) stated that the Secretary of the Interior "shall provide against the wanton destruction of the fish and game found within said Park. . . ." But, this was an era before people, including many biologists, understood the concepts of ecosystem and the interconnectedness of species. At the time, the wolves' habit of killing prey species was considered "wanton destruction" of the game, and those who poisoned every carcass they passed in the backcountry (loading strychnine into carcasses was the easiest way to kill wolves) did so believing they were supporting the Organic Act.

### Restoration

The last wolves were killed in Yellowstone in 1923. Within two decades, biologists were aware of the lack of foresight shown by that act. With an increasing understanding of the complex relationships that exist in nature, it was recognized that elimination of a species could upset a delicate natural balance that had evolved through centuries. For example, while wolves will kill any large animal they can bring down, the nature of predator-prey relationships means that wolves will kill more of the very young, the very old, and the sick than of healthy, prime animals. Thus, wolves will help keep a prey population fit. In the 1960s, National Park Service policy regarding human management of Yellowstone's wildlife populations changed to a policy of allowing those populations to manage themselves. Many suggested at the time that for such regulation to succeed, the wolf had to be a part of the picture.

Also in the 1960s, a national awareness of environmental issues and consequences led to the passage of many laws that were designed to correct the mistakes of the past and help prevent similar mistakes in the future. One such law was the Endangered Species Act. The U.S. Fish and Wildlife Service is required by this law to restore endangered species that have been eliminated, if possible. (National Park Service policy also calls for restoration of native species where possible.)

The long, complex, and difficult process of wolf restoration began in earnest in the latter 1970s. An extensive and lengthy research and public review process culminated in an environmental impact statement being approved in 1994 that established guidelines for wolf recovery in three areas of the Rocky Mountains, including the greater Yellowstone ecosystem. It contained special management rules to aid the wolf recovery process in Yellowstone while recognizing the importance of the livestock industry to the region's economy.

The recovery process began when a small number of gray wolves were captured in western Canada and transported to Yellowstone and central Idaho in early 1995. In Yellowstone, the wolves were placed in large acclimation pens for a period of time to allow them to adjust to their new surroundings before being set free. In January 1996 another shipment of wolves from Canada was brought to Yellowstone, acclimated, and then released.

The greater Yellowstone ecosystem is now home to about 115 gray wolves. While the reintroduction has not been without problems, researchers consider the effort to date a great success. They credit both the supreme adaptability of the wild wolves and the fact that the region contains some of the best wolf habitat in the world. The goal of Yellowstone's restoration project is to establish a self-sustaining gray wolf population of 10 breeding pairs of wolves in the greater Yellowstone ecosystem.



## Black Bears

As of March 2000 . . .

### **Number in Yellowstone**

- 500–600

### **Where to see**

Tower and Mammoth areas.

### **History**

- Along with grizzlies, used to be fed at dumps within the park.
- For years, black bears would be fed from vehicles.
- Both of these actions resulted in bears losing fear of humans, pursuing human food, which resulted in visitor injuries, property damage, and having to destroy “problem bears.”

### **Management Status**

- 1960, black bear management program implemented, which has reduced the number of bear-caused human injuries and property damage; and has re-established black bears in a natural state.
- No research since the 1960s, but black bears have benefited from management efforts aimed at recovering the grizzly bear.
- Because they are not seen as often as in the past, many visitors believe the population of black bears has declined. However, bear sighting reports suggest that black bear numbers are good.

The smallest and most widely distributed bear in North America is the black bear, *Ursus americanus*, which was once abundant in most wooded and mountain areas of the continent. Today the animal is not as numerous as it used to be, especially in the East and Midwest.

The “black” in the name refers to a type of bear rather than a color. The bluish glacier bear of Alaska, the white Kermode’s bear of coastal British Columbia, and many bears ranging from black to brown, cinnamon, and blonde are all black bears. In Yellowstone, about 50 percent of black bears are black, with others mostly brown and cinnamon. Black bears stand about 3 feet high at the shoulder. Boars (males) weigh about 210 to 315 pounds, sows (females) 135 to 160 pounds; an exceptional male can weigh 500 pounds. Life expectancy is about 15 to 20 years in the wild. Black bears have fair eyesight and an exceptional sense of smell.

Bears are omnivorous—that is, they eat almost anything, including grass, berries, fruits, tree bark, roots, bird eggs, nuts, insects, fish, and carrion. Their short, curved claws enable them to climb trees with great agility, but do not allow them to dig for roots or ants as well as a grizzly bear can (grizzlies have longer, stronger claws).

Black bears are less aggressive than grizzly bears. When faced with a threat, they are more likely to retreat up a tree or flee outright and less likely to be aggressive as a response. However, “less likely” means just that as any bear, particularly a female with cubs, may attack when surprised at close range. Always give bears a wide berth.

During fall and early winter, bears become fat and sleek. They look for a cave or den where they hibernate until spring. There is some discussion among scientists as to what constitutes true hibernation. Some animals experience an extreme drop in metabolism with a cooling of body temperature and near stoppage of respiration and circulation. Bears undergo these changes but to a less dramatic extent than some other species like marmots or ground squirrels. A bear can be easily roused from its hibernation. Most scientists today consider bears to be true hibernators.

For the better part of the year, males and females without cubs are solitary, living individually on home ranges of 6 to 124 square miles for males and 2 to 45 square miles for females. The exception is during the mating season, the height of which is late June to early July. Promiscuity is common, although pairs will occasionally stay together for the entire period. For both genders, the usual first breeding season is at age 4. After fertilization, the barely developed blastocyst (egg) does not immediately implant in the uterus, a process called “delayed implantation.” If the bear is healthy, when she dens for the winter, implantation and development will begin (if not, her body will abort the blastocyst). Total gestation time is 200 to 220 days, but only during the last half of this period does fetal development take place.

Birth occurs in mid-January; the female becomes semiconscious during delivery. Usually there are two cubs in a litter, though there may be one or three; four are rare. The new cubs are blind, toothless, and practically naked of hair. After delivery the mother continues to sleep for another two months, during which time the cubs alternately suckle and sleep.

After emerging from the den, the cubs and their mother roam over her home territory. The animals have no regular den and sleep wherever they happen to be. In the fall, the cubs den with their mother. During the next summer’s mating season, the mother is no longer interested in these cubs and separates from them (they are about 16 months old).

## Grizzly Bear

As of March 2000 . . .

### Number in Yellowstone

- Estimated 350–400 bears

### Where to see

- Grizzly bears are most commonly seen during the summer at dawn and dusk in the Hayden Valley and the Antelope Creek/Lamar Valley areas.

### Food

- Elk calves, cutthroat trout, small rodents, ants, moths, vegetation

### Status

- Although grizzly bears once roamed from Mexico to the Arctic Ocean, Yellowstone is one of only two major areas south of Canada still inhabited by grizzly bears.
- In July, 1975, the grizzly bear was listed as a threatened species under the authority of the Endangered Species Act (ESA).

### Current Management

- A recovery plan and conservation strategy have been produced. See Chapter 8.
- See “Bear Management History” in this chapter, and related articles in Chapter 8.

Brown bears (*Ursus arctos*) crossed the Bering Land Bridge from Asia about 50,000 years ago and spread into North America. The grizzly bear (*Ursus arctos horribilis*) is a subspecies of brown bear that once roamed the mountains and prairies of the American West. Today, the grizzly bear remains in a few isolated locations in the lower 48 states, including Yellowstone.

Grizzly bears are larger than black bears and can usually be distinguished by longer, curved claws, humped shoulders, and a “dished-in” face. Their coats range in color from light brown to nearly black. The name “grizzly” comes from the frequent presence of silver-tipped or “grizzled” hairs on the animals’ coats. However, the coloration of black and grizzly bears is so variable that it alone is not a reliable means of telling the two bears apart. Particularly when bears are not fully grown or when seen only briefly or at a long distance, it can be difficult to correctly identify one bear species from another.

In greater Yellowstone, male grizzly bears average 400 to 600 pounds and females 250 to 350 pounds in size. An occasional male may exceed 800 pounds. Adults stand 3 to 4 at the hump when standing on all four legs. They may rear up on their hind legs to more than 8 feet in height; standing up improves their opportunity to see and smell. Grizzlies have adapted to be fast sprinters—running up to 45 miles per hour for short distances. There is a record in the greater Yellowstone area for a wild grizzly bear living to at least 28 years.

It is commonly said that grizzly bears cannot climb trees. This is not strictly true, especially when the bears are small. As grizzlies increase in size and as their claws grow longer, it becomes more difficult for them to climb. Stories that bears cannot swim or run downhill are also persistent—and incorrect.

Bears are generally solitary, although they may tolerate other bears being nearby when food is not a limiting resource. Mating season occurs from mid-May to mid-July, and bears may mate with multiple partners during a single season. Females do not breed until at least age 4 or 5. Bears expe-

rience “delayed implantation,” meaning that the embryos do not begin to develop until late November or December. This appears to be a strategy allowing the mother bear to save up energy until entering her winter den, where the cubs are born in late January or February. Two or three cubs is common, but several times in recent years observers in greater Yellowstone have seen females with litters of four cubs. Male bears take no part in raising cubs and in fact may pose a threat to younger bears. Another grizzly will usually keep her cubs with her for two winters following their birth, after which time she (or a prospective suitor) chases the 2-year-old subadult bears away so she can mate again.

The grizzly’s need for space is large. Their individual home range must contain food, water, and cover throughout all seasons of the year. Although the size of home ranges varies greatly, research shows that males in greater Yellowstone use from 520,392 to 1.3 million acres. Female ranges are considerably smaller, from 133,681 to 343,716 acres. Female cubs frequently establish their home range in the vicinity of their mother, but male cubs must disperse farther in search of a home.

Grizzly bears are omnivorous. They can be effective predators, especially on such vulnerable prey as elk calves and spawning cutthroat trout. They also scavenge meat when available, such as from winter-killed carcasses of elk and bison or from road-killed wildlife. They eat small mammals (such as pocket gophers) and insects (such as ants and army cutworm moths that summer on high-elevation talus slopes). Amazingly, despite their small size, insects are important, high-protein foods for grizzly bears. Grizzly bears have long, straight claws and a large shoulder muscle mass, which makes them quite efficient at digging for food items in the soil such as roots, bulbs, corms, and tubers, as well as rodents and their caches. They eat a wide variety of plants, including white-bark pine nuts, berries, tubers, roots, sedges, and grasses. They eat glacier lilies and dandelions, yampas and biscuitroots, horsetails and thistles. And, of course, they will eat human food and garbage where they can get it; that is why managers have emphasized that keeping human foods secure from bears increases the likelihood that humans and bears can peacefully co-exist in greater Yellowstone.

Grizzlies have a social hierarchy in which adult male bears dominate the best habitats and food sources, generally followed by mature females with cubs, then by other single adult bears. Subadult bears, those just learning to live on their own away from mother’s protection, are the lowest on the social ladder and most likely to have to make a living in poor-quality habitat or in areas nearer roads and developments. Thus, young adult bears are most vulnerable to danger from humans and other bears, often becoming “habituated”—an unacceptable tolerance for humans that often results in a bear being transferred, or ultimately removed, from the wild population.

Bears spend most of their time feeding, and this effort increases during “hyperphagia,” the pre-denning period in autumn. Bears enter their winter dens between mid-October and early December. Dens are usually dug on steep slopes where deep snow will accumulate, providing an added layer of insulation for the sleeping bear(s).

### ***Feeding Bears***

- As early as 1889, bears were gathering at night to feed on garbage piles behind park hotels.
- The first incidents of bears panhandling for food along park roads were reported in 1910.
- The first confirmed bear fatality occurred in 1916.

### ***Early Management***

- In 1931, the park began keeping detailed records of bear-inflicted human injuries, property damage, and bear control actions.
- From 1931–1969, an average of 48 bear-inflicted human injuries and 138 incidents of property damage occurred annually in Yellowstone.

### ***Changes in Management***

- In 1970, Yellowstone implemented a new bear management program with the objectives of restoring the grizzly and black bear populations to subsistence on natural foods and reducing the number of injuries and property damage.
- Regulations prohibiting the feeding of bears were strictly enforced, as were regulations that required human food and garbage be kept secured from bears.
- All garbage cans in the park were converted to a bear-proof design, and garbage dumps within and adjacent to the park were closed.

### ***Current Status***

- In 1975, the grizzly bear population in the Yellowstone ecosystem was listed as a Threatened Species under the authority of the Endangered Species Act.
- Human injuries have decreased to an average of 1 injury per year in the 1990s from 45 injuries per year in the 1960s.
- Property damage claims have decreased to an average of 7 per year in the 1990s from 219 per year in the 1960s.
- Bears that must be killed or removed from the park have decreased to an average of .2 black bear and .3 grizzly bear per year in the 1990s from 33 black bears and 4 grizzlies per year in the 1960s.
- Bear relocations from away from the frontcountry have decreased to an average of .4 black bear and .9 grizzly bear per year in the 1990s, from more than 100 black bears and 50 grizzlies per year in the 1960s.
- For more detailed information on current management, see Chapter 8.

Grizzlies have always been a part of the history of greater Yellowstone. Native Americans hunted bears and invoked their spirits in ceremonies and dances. Early European explorers into the region noted seeing bears on the Great Plains and in the mountainous regions where they were hunting and trapping. After Yellowstone became a national park in 1872, increasing numbers of visitors came into the region, and they developed an early interest in the area's wildlife—especially the bears.

As early as 1889, bears were gathering nightly at the first park hotels, feeding on garbage discarded in open pits. Dumps as bear-viewing sites quickly became a primary tourist attraction, and this situation continued for decades in Yellowstone National Park and in the surrounding towns of

Gardiner, Cooke City, and West Yellowstone, Montana. At the height of the bear-feeding era, hundreds of people sat nightly in bleachers and watched as grizzly and black bears came to feed on specially built garbage platforms.

Despite the official prohibition in 1902 against hand-feeding the bears, Yellowstone National Park became known as the place to see and interact up-close with the popular animals. Roadside bears, often receiving handouts from enthusiastic park visitors, caused a common experience: “bear jams”—a traffic jam resulting from the presence of one or more photogenic park bears, black or grizzly, often with a park ranger standing by to direct traffic, answer questions, and even pose for pictures.

As park visitation and the number of bear-human conflicts began to increase, park managers became more concerned about the situation. By 1931, the park was keeping detailed records of bear-caused human injuries, property damages, and subsequent nuisance bear control actions. During the 29-year period from 1931 to 1969, an average of 48 people were injured by bears within the park each year. In addition, bears caused an average of 98 incidents of property damage each year. As a result, park personnel removed an average of 3 nuisance grizzly bears and 22 nuisance black bears each year. The second known bear-caused fatality occurred during this period when an unknown species of bear killed a woman in the Old Faithful campground in 1942. (The first bear-caused human fatality within Yellowstone occurred in 1916 when a grizzly bear killed a wagon teamster in a roadside camp. At the time, park managers considered this bear’s behavior to be completely out of the ordinary.) After the 1942 fatality, Congress criticized the park for failing to solve its bear problems.

In 1959 and continuing through 1971, a pioneering ecological study of grizzly bears occurred in Yellowstone under the direction of Dr. John Craighead and his brother, Frank. Their research provided the first scientific data about grizzlies in greater Yellowstone. From the time the park was established through the 1950s, bear management had been somewhat informal, with little biological understanding of the species. Most management efforts were directed at the bears that were causing problems and not at the underlying causes leading to bear-human conflicts. Overly troublesome bears were simply removed as necessary. The Craigheads’ study as well as other studies elsewhere provided park managers with data about bears and their habitat requirements.

In 1960, a National Park Service bear management program was implemented. The program was designed to reduce the number of bear-caused human injuries and property damages that occurred within the park and to re-establish bears in a natural state. The program included expanded efforts to educate visitors about bear behavior and the proper way to store food, garbage, and other bear attractants; more prompt removal of garbage to reduce its availability to bears and the development and use of bear-proof garbage cans; stricter enforcement of regulations that prohibited the feeding of bears; and, the removal of potentially hazardous bears, habitual beggar bears, and those bears that damaged property in search of food. These guidelines were directed primarily at the management of black bears and were largely in response to public complaints of personal injury and property damage caused by roadside and campground bears.

After 10 years of this bear management program, 332 nuisance black bears and 30 nuisance grizzly bears had been removed from the population. However the number of bear-caused human injuries decreased only slightly, to an average of 45 each year. Consequently, in 1970, Yellowstone initiated a new, more intensive bear management program with the objectives of restoring the grizzly bear and black bear populations to subsistence on natural forage and reducing bear-caused injuries to humans. As part of this management program, a controversial decision was made to eliminate the unsanitary open-pit garbage dumps inside the park (eventually the garbage dumps adjacent to the park in West Yellowstone, Gardiner, and Cooke City, Montana, were also closed). The long-term goal was to wean bears away from the unnatural concentrations of food and back to a natural distribution and a diet of plant and animal foods available throughout the ecosystem.

The Craigheads objected to this plan and predicted that it would cause bears to range more widely, resulting in more bear-human conflicts and subsequent bear mortalities. This indeed occurred in the short-term as the bears were forcibly weaned away from an easy food source that many of them had come to rely on. During the first three years of the program, an average of 38 grizzly bears and 23 black bears were trapped each year and translocated from roadsides and developed areas to backcountry areas. In addition, an average of 12 grizzly bears and 6 black bears were

removed from the population each year. However, bear-caused human injuries decreased significantly to an average of 10 each year. After 1972, the number of bear-human conflicts as well as the number of bear management control actions declined significantly.

In 1983, the park implemented a new grizzly bear management program. The 1983 program was similar to the 1970 program, but with greater emphasis on habitat protection in backcountry areas. As part of the 1983 bear management plan, the park established “bear management areas” where recreational use was restricted in areas with seasonal concentrations of grizzly bears. The goals behind these restrictions were to minimize bear-human interactions that might lead to habituation of bears to people, to prevent human-caused displacement of bears from prime food sources, and to decrease the risk of bear-caused human injury in areas with high levels of bear activity. This program continues today.

Analysis of the data indicates that most bear-human conflicts before 1983 involved food-conditioned bears aggressively seeking human foods. In contrast, from 1983 to 1993, most bear-human conflicts involved habituated, but not food-conditioned, bears seeking natural foods within developed areas or along roadsides. Since 1983, bear-caused human injuries have declined to an average of 1 per year, and the number of nuisance bears translocated has also declined (for grizzly bears to 2 per year and for black bears to 1 per year). The number of incorrigible bears removed from the population has also declined significantly from earlier periods. The long-term goal of forcing bears to relearn how to be “natural bears” appears to have been a success.

### The Grizzly Is Listed as a Threatened Species

The grizzly bear in the lower 48 states was listed as “threatened” under the Endangered Species Act in 1975. Although grizzlies originally ranged throughout western North America from the Arctic Ocean to central Mexico, at the time of listing, the species was reduced to living in only about 2 percent of its former range south of Canada. Five or six small populations were thought to remain, totaling 800 to 1,000 bears. The southernmost—and most isolated—of those populations was in greater Yellowstone, where some 250 to 300 grizzly bears were thought to have remained by the mid-1970s.

The listing of the grizzly for protection under the Endangered Species Act resulted in cessation of grizzly bear hunting, as well as the development of numerous plans and guidelines to protect the remaining bears and their habitat within an identified recovery area. The Yellowstone grizzly bear recovery area is approximately 9,500 square miles in size and includes all of Yellowstone National Park and the John D. Rockefeller, Jr. Memorial Parkway as well as significant portions of Grand Teton National Park and the Bridger-Teton, Shoshone, Gallatin, Targhee, Custer, and Beaverhead national forests. It also includes Bureau of Land Management lands and state and private lands in Idaho, Montana, and Wyoming.

Research and management of grizzlies in greater Yellowstone intensified after the 1975 establishment of the Interagency Grizzly Bear Study Team (IGBST). The team, in cooperation with state wildlife managers in Idaho, Montana, and Wyoming, have monitored bears, estimated the number and trend of the population, and enhanced our understanding of grizzly bear food habits and behavior in relation to humans and to other wildlife species. Because of the IGBST and the earlier Craighead studies, greater Yellowstone managers have amassed the longest continuous data-base for any grizzly bear population in the lower 48 states.

In 1983, the Interagency Grizzly Bear Committee (IGBC) was created in order to increase the communication and cooperative efforts among managers of grizzly bears in all recovery areas. The IGBC includes the heads of state wildlife management agencies, regional national park and forest managers, and representatives of the U.S. Fish and Wildlife Service, which has primary responsibility for implementing the Endangered Species Act. Twice each year, these managers have met to discuss common challenges related to grizzly bear recovery. They have supervised the implementation of public education programs, sanitation initiatives, and research studies to benefit the grizzly bear populations in Yellowstone and the other recovery areas in the lower 48 states.

Scientists and managers believe that despite the continuing growth in human use of greater Yellowstone, the grizzly population has been stable to slightly increasing since 1986. Indications are that bears are reproducing well and raising cubs in nearly all portions of the recovery area. The

rate of cubs surviving to adulthood is high (about 33 percent), and the average litter size has increased from 1.9 observed in the mid-1970s to 2.15 in the mid-1990s. More and more frequently, bears have been seen well outside Yellowstone National Park, south into Wyoming's Wind River Range, north throughout the Gallatin Range, and east of the Absarokas onto the plains. By tracking radio-collared bears, we know that these are not "park bears" leaving Yellowstone for places beyond, but previously unmarked bears and offspring dispersing into new and vacant but suitable habitats. In 1996, scientists estimated with 90 percent confidence that the Yellowstone grizzly population was between 280 and 610 bears. While many people may wish for a more precise estimate, it is not possible to count wide-ranging and fairly solitary animals like bears with any degree of accuracy.



## Bison

As of March 2000 . . .

### Number in Yellowstone

- 2,200–2,500 estimated
- Three primary herds: the Mary Mountain herd that migrates between Hayden Valley and Fountain Flats, the Northern herd in Lamar Valley, and the Pelican herd in Pelican Valley.

### Where to see

Hayden and Lamar valleys year-round; plus Firehole Valley and thermal areas in winter.

### History

- Yellowstone is the only place in the lower 48 states to have a continuously free-ranging bison population since prehistoric times.
- In the 1800s, market hunting, sport hunting, and a U.S. Army campaign nearly resulted in the extinction of the American bison.
- By 1902, poachers reduced Yellowstone's small herd to about two dozen animals. The U.S. Army, who administered Yellowstone at that time, protected these bison from further poaching.
- Bison from private herds augmented the native herd.
- For decades, bison were intensively managed due to belief that they, along with elk and pronghorn, were overgrazing the park.
- By 1968, manipulative management (including herd reductions) of bison ceased and natural ecological processes began. In 1994, the population reached its peak at 4,200 animals.

### Current Issues

- See Chapter 8 for articles on management & brucellosis.

More than 60 million bison (*Bison bison*) may have roamed North America in the 1800s. Their historic range spread from the Pacific to the Appalachians. They were once found in what is now western New York, Pennsylvania, and Virginia, but, as a result of over hunting, they disappeared from east of the Mississippi by 1832.

While bison were found throughout the country, their main habitat was the Great Plains. For millennia bison had roamed there in herds that often numbered three to five million animals. Plains tribes developed a culture that depended on bison. Almost all parts of the bison provided something for the Native American's way of life—food, tools, shelter, or clothing. No part of the animal was wasted; even the dung was burned for fuel. Hunting bison required skill and cooperation as the animals were herded/chased into traps or run over cliffs. The acquisition of the horse from the Spanish in the 1600s fundamentally changed many tribes' way of life as bison could now be hunted more easily, and many tribes prospered.

But Euro-American settlers moving west changed the balance. Starting about 1855, bison were hunted by the new settlers in large numbers for their hides and tongues, the latter considered a delicacy. About the time Yellowstone was established as a national park in 1872, superior methods for processing bison leather were developed by a New York tanner. Shortly thereafter, huge orders for hides from the eastern states and Europe resulted in hide hunters flocking to the plains by the thousands. By 1885, only isolated herds of bison were left, mostly captive animals on ranches.

Yellowstone is the only place in the lower 48 states where a population of wild bison persisted. Primarily because of poaching, Yellowstone bison numbers declined significantly. The poaching of these last bison was interrupted by the U.S. Army. The near loss of bison in the wild resulted in a large public outcry and the swift passage of the Lacey Act, which prohibits hunting in national parks. The story of the near extinction of bison in the U.S. and their protection in Yellowstone is one of the great triumphs of the American conservation movement.

In 1902, fearing the demise of the wild herd (only 23 were counted), the U.S. Army brought 21 bison from ranches to Yellowstone, and the Buffalo Ranch in Lamar Valley was constructed where these bison were managed as on a ranch. During the next several decades, these bison and the park's remaining wild ones flourished. For many years it was believed that Yellowstone's bison were not the plains bison but a different subspecies known as the mountain bison. However, biologists now believe that there is no distinction between these two types of bison. The slight differences in appearance of Yellowstone bison, the larger size and hump, are likely an adaptation to the deep snows and harsh environment of the high mountain plateau.

When domestic bison were brought to Yellowstone and actively managed at the Lamar Buffalo Ranch, the goal was to increase the herd size. National Park Service policy began to shift in the 1930s to the preservation of bison in a more natural state with less artificial manipulation. Consequently, the fences at the Buffalo Ranch were removed, and the ranched bison were allowed to intermingle with the native bison; however, bison were still periodically culled until the late 1960s. Culling was based on carrying-capacity studies conducted from a range management perspective, which suggested a maximum population that Yellowstone's northern range could sustain. Bison were rounded up or hay-baited in the Lamar Valley, and numbers were controlled by regular reductions (this was also done with elk). In 1966, NPS management policy changed to one of allowing natural regulation management to occur to the maximum extent possible. Since artificial regulation of numbers was stopped in the 1960s, the bison population has risen steadily, reaching about 4,200 animals in 1994. Today, there are between 2,200 and 2,500 bison in Yellowstone.

As members of the cattle family, the bison is the largest land mammal in North America. Large bulls commonly weigh up to 2,000 pounds and cows about 1,000 pounds. Both sexes have horns, those of the cow being slightly more curved and slender than the bull's. The bison's pelt is thicker on the forward part of its body, especially in winter. Bulls are more massive in appearance toward the front of their bodies than cows, and more bearded. Bison are sexually mature at age 3 and fully mature at age 8. Life span averages 12 to 15 years, but occasional individuals live as long as 40 years. For their size, bison are remarkably agile and quick, capable of speeds in excess of 30 mph. Ill tempered overall, their docile appearance results in several injuries to park visitors each summer, for bison will often gore those who approach them closely. Grasses and, especially, sedges are their chief food, accounting for about 96 percent of their diet. During winter, bison use their massive head to plow snow side to side as they forage.

Overall, large herds of bison will be composed of cows, calves, and perhaps 1/4 to 1/3 bulls. Most bulls, however, spend the majority of the year by themselves or in small groups. Breeding (the "rut") occurs in late July and August. Furious fighting for cows precedes the actual mating; injuries are common but fatalities rare. After a gestation period of 9 to 9-1/2 months, single reddish-brown calves are born in late April and May. Calves can keep up with the herds about 2-3 days after birth, and predation of calves by bears and mountain lions has been almost non-existent; the extent to which wolves will prey on bison calves is not yet known. Calves nurse through most of their first year. Because of this, yearlings facing their second winter have a lower survival rate than calves facing their first winter.

Adult bison have had no large predators for many decades, although the restoration of wolves in Yellowstone is changing that. Many insects prey upon the bison, and bison will rub against trees, rocks, or in dirt wallows in an attempt to rid themselves of insect pests. Sometimes birds (most notably the brown-headed cowbird) "ride" a bison in order to feed on insects in its coat. While not subject to much predation, as carrion the bison is an important source of food for scavenger species (in winter) and bears just out of their dens in spring.

For information on bison management, brucellosis, and the EIS, see Chapter 8.

## Elk

As of March 2000 . . .

### Number in Yellowstone

- Summer: Approximately 35,000 elk in seven different herds
- Winter: Approximately 10,000–20,000 that winter here
- Two major herds:
- Northern Range: 11,000–14,000 animals in winter
- Firehole-Madison: 650–850 animals, year round.

### Where to see

Summer: Gibbon Meadows, Elk Park, and Lamar Valley  
 Autumn, during “rut” or mating season: Mammoth Hot Springs  
 Winter: migrate south to the Jackson Hole Elk Refuge in Jackson, Wyoming, or north around Gardiner, Montana. A few winter in thermal areas.

### Management

- See the article on the Northern Range in Chapter 8.

Elk (*Cervus elaphus*) are the most abundant large mammal found in Yellowstone. Euro-American settlers used the word “elk” to describe the animal, however, this is the word used in Europe for moose (causing great confusion for European visitors). The Shawnee word “wapiti,” which means “white-rumped deer,” is another name for elk. The North American elk is considered the same species as the red deer of Europe, with which it can interbreed and produce fertile offspring.

Elk are grazers and prefer grasses. An average, mature bull elk weighs about 700 pounds and is about 5 feet tall at the shoulder. Cows weigh about 550 pounds and are slightly shorter. Calves are usually 30 to 40 pounds at birth (most are born around June 1st). Calves are born light brown with white spots and have little scent, providing them with good camouflage from predators. While they can walk within an hour of birth, they spend much of their first week to ten days bedded down between nursings. The first year is a difficult one for elk calves. Summer losses due to predators average 1/3—and can exceed 1/2—of the calf population. Elk calves are food for black and grizzly bears, wolves, coyotes, mountain lions, and golden eagles. Elk that reach maturity commonly live about 12 to 15 years; rare individuals may live to 25 years.

The mating season (rut) generally occurs around early September to mid-October. At this time, elk gather in mixed herds—lots of females and cows, with a few bulls nearby. The bulls bugle to announce their fitness and availability to females and to warn and challenge other bulls. When answered, bulls move toward one another and engage in battle for possession of the cows. The battle involves a crashing together of antlers accompanied by intense pushing and wrestling for dominance. While loud and extremely strenuous, only rarely does any serious injury befall a participant. The weaker bull ultimately gives up and wanders off. The end of the rut coincides with the coming of cold weather and the migration to wintering grounds.

Yellowstone’s elk live in an environment characterized by long winters that range in severity of temperature and snowfall. Climate is the most important factor affecting the size and distribution of elk herds here. While nearly the entire park provides summer habitat for approximately 35,000 elk (in 7 herds), winter snowfalls force elk and other ungulates to leave most of the park. The number of elk that winter in the park averages between 10,000 to 20,000.

The northern, lower-elevation portion of Yellowstone, where temperatures are more moderate and snowfall less than in the park interior, can support large numbers of wintering elk. In fact, the northern Yellowstone herd is the largest herd of elk in the United States. The herd winters in the area of the Lamar and Yellowstone river valleys from Soda Butte to Gardiner, Montana.

Only one herd lives both winter and summer in the interior of the park in the valleys of the Madison and Firehole rivers. The Madison-Firehole elk herd has been the focus of a research study since November 1991. This herd numbers from 650 to 850 animals. The population appears to be naturally regulated to a degree not found in other, human-hunted elk herds. Researchers are examining the effects of environmental variability on ungulate reproduction and survival. This herd has both high survival and high reproduction rates. Information gained in this study will be useful in comparing unhunted and hunted elk populations.

These same researchers have also examined elk use of areas burned in the wildfires of 1988. Observations indicate that elk made extensive use of burned trees; tests showed that fires altered the chemical composition of lodgepole pine bark, making it more digestible and of higher protein content than live bark. While the burned bark was not the highest quality forage for elk, it is comparable to other low-quality browse species. The researchers speculate that elk select burned bark because it is readily available above the snow cover in winter.

Other findings show that high quality forages growing throughout the winter in association with thermal features are apparently significantly lower in digestibility than expected. Also, arsenic from geothermal water accumulates in aquatic plants growing in the Firehole River. Although arsenic is extremely toxic, radio-collared elk commonly feed on the aquatic plants throughout the winter, with no apparent ill effects.

### Horns vs. Antlers

Antlers, found on members of the deer family, grow as an extension of the animal's skull. They are true bone, are a single structure, and, generally, are found only on males. Horns, found on pronghorn, bighorn sheep, and bison, as well as on cattle, are a two-part structure. An interior portion of bone (also an extension of the skull) is covered by an exterior sheath grown by specialized hair follicles (similar to human fingernails). Antlers are shed and regrown yearly while horns are never shed and continue to grow throughout an animal's life. However, one exception is the pronghorn, which sheds and regrows its horn sheath each year.

Antler growth is triggered in spring by a combination of two factors: a depression of testosterone levels and a lengthening photoperiod. The first result of this change is the casting or shedding of the previous year's "rack." New growth begins shortly thereafter. Growing antlers are covered with a thick, fuzzy coating of skin (the blood vessels of which are depositing the bone that makes up the antler) commonly referred to as "velvet." Usually around early August, further hormonal changes signal the end of growth, and the animal begins scraping the velvet off, polishing and sharpening the antlers in the process.

The growing period is shortest for yearlings (about 90 days) and longest for healthy, mature individuals (about 140 days). Roughly 70 percent of the antler growth takes place in the last half of the period, when the antlers of a mature elk will grow 2/3 of an inch each day. A typical healthy bull will have antlers 55 to 60 inches in length with a spread of just under six feet and a weight of about 30 pounds.

An average, mature, healthy bull elk will bear antlers that are symmetrical, each with six tines. There is great variation among individuals, of course, including asymmetry, malformations, and occasional racks on females. The mature bull is usually referred to as a "six-point" or a "six by six." The latter style of reference refers to left antler points by right antler points and is convenient especially when referring to elk with asymmetric antlers.

Bull elk begin growing their first set of antlers when they are (about) one year old. Commonly, these antlers will consist of simple spikes ranging in length from 10 to 20 inches and occasionally forked at their tips. The second set of antlers will usually possess four to five points, although the antlers themselves will be quite slender compared to an older bull's. The third set will also be four to five points (on average), and will begin to approach the thickness and breadth of a more mature bull. The fourth set and beyond will typically bear the six-point configuration, although they will continue to thicken and lengthen each year. As a percentage of the animal's body weight, the finest antlers produced are the 11th or 12th set. After this time, as the animal approaches senility, antler mass and size will begin to diminish.

Elk retain their antlers through the winter. When antlered, bulls usually settle disputes by wrestling with their antlers. When antlerless, they use their front hooves (as cows do), which is more likely to result in injury to one of the combatants. Because elk spend the winter in herds with other bulls or with gender-mixed herds, retention of antlers means fewer injuries sustained overall. Also, bulls with large antlers that are retained longer are at the top of elk social structure, allowing them preferential access to feeding sites. Moose and deer are not as gregarious an animal as elk. Retaining antlers during the winter is costly from an energy standpoint, and moose and deer do not usually carry their antlers very long after their rutting season.

With the rut behind them, testosterone levels in bull elk drop during the winter. When they have reached a certain low level and combined with the lengthening day, the antlers are shed in preparation for growing new ones. While there is variation, most bulls drop their antlers between mid-February to late March. Bulls that frequent mixed herds for the winter will usually drop their antlers about 10 days later than those in “bachelor clubs,” while aged bulls often drop theirs earlier than those in their prime.

## Moose As of March 2000 . . .

### Number in Yellowstone

- 300–500

### Where to see

- Look in riparian areas around Yellowstone Lake and along the Madison, Gallatin, Snake, and upper Yellowstone rivers.

### Other Info

- Population of moose on the northern range has decreased since 1960s.
- One factor may be burning of winter spruce-fir habitat in 1988.
- Other factors may be competitive exclusion by elk, the loss of old growth forests, and mortality from hunting outside the park.

Moose (*Alces alces shirasi*), the largest member of the deer family, were reportedly very rare in northwest Wyoming when Yellowstone National Park was established in 1872. Subsequent protection from hunting and wolf control programs may have contributed to increased numbers, but suppression of forest fires probably was the most important factor as moose are dependent on mature fir forests for winter survival. By the 1970s, an estimated 1,000 moose inhabited the park.

Like most deer family members, bull moose are antlered and the cows are not. The antlers are flat and palmate (shaped like a hand). Bulls average about 900 pounds, the largest can be as much as 1,400 pounds. Cows average about 675 pounds. Moose are a chocolate brown, often with tan legs and muzzle, and possess a waggle or bell, a 6- to 10-inch growth of skin and hair that hangs from the throat. Its purpose or function is unknown. The moose is an excellent swimmer and is as likely to cross a lake as walk around it. Moose mature at about 2 to 3 years of age; the average life span for moose is 18 to 20 years. Despite its size, a moose can slip through the woods without a sound. Moose, especially cows with calves, are unpredictable and often belligerent.

Moose are well known for feeding while standing in water, where they seek aquatic plants like water lilies, duckweed, and burweed. But the principle staple of the moose diet are the leaves and twigs of the willow, followed by other woody browse species such as balsam, birch, maple, and mountain ash. An adult moose consumes at least 40 to 50 pounds of browse per day.

On-going research with radio-collared moose has revealed some interesting insights into moose migration in winter. Some moose that summer in the park migrate to lower elevations west and south of Yellowstone in winter where willow remains exposed above the snow. But many moose move to higher elevations (to as high as 8,500 feet) to winter in mature stands of subalpine fir and Douglas-fir. They browse almost exclusively on the twigs and needles of these conifers. In thick fir stands, much of the snow builds up on the branches of the trees, meaning there is less snow on the ground beneath the trees, which facilitates easier movement for the moose.

Moose are solitary creatures for most of the year, except during the rut, which lasts from mid-September until the end of November. Both genders are vocal at this time: the cows may be heard bellowing in search of a mate, and bulls challenge one another with low grunts before clashing with their antlers. A bull moose on the offensive tries to knock its opponent sideways. If such a move is successful, the challenger follows through with another thrust of its antlers. Such a thrust may puncture the ribs and drive one of the several short prongs on the outer edges of the antlers into a vital organ. Normally before such a thing happens, however, the weaker animal gives up. The victor stays for a week to ten days with the cow that it has won before going on to do battle

again for another cow.

In December, shortly after the rut is finished, bulls will shed their antlers. This conserves energy, thereby promoting easier winter survival. Cows are pregnant through the winter; gestation is 7 to 7 months. In early May, the cow will drive off any previous year's offspring that may have wintered with her and seek out a thicket to drop her new calf. A cow's first-born is a single calf; thereafter twins are often born, with triplets a rarity.

Calves are born covered with hair and with their eyes open. The muzzle is black and there are dark spots over each eye. A calf walks a few hours after birth and stays close to its mother. It is often the prey of bears or wolves and less frequently of mountain lions, coyotes, or wolverines. An adult moose can usually outrun these predators or trample them to death.

During the summer, the bulls grow new antlers to replace those shed in December. In April or May small bumps on each side of the forehead start to swell, then enlarge until they are knobs covered with a black fuzz and fed by blood which flows through a network of veins. Finally the knobs change into antlers: spikes 6 to 8 inches long for a yearling; a fork-horn for a two-year old; and narrow palmate antlers with 3 or 4 irregular points for a three-year old. By August antlers are fully developed. As a bull rubs and polishes his antlers on small trees without low branches the antlers become hard and brown. When a bull reaches maturity at 12 to 15 years, the antlers may be as wide as 5 feet from tip to tip. Beyond maturity, the antlers and bell of a bull moose become smaller.

Recent research on the northern range indicates that the moose calf crop has been declining since the fires of 1988. During that summer there was also high predation of moose by grizzly bears in small patches of surviving timber. The winter following the fires many old moose died, probably as a combined result of the loss of good moose forage and a harsh winter. Unlike moose habitat elsewhere, northern Yellowstone does not have woody browse species that will come in quickly after a fire and extend above the snowpack to provide winter food. Therefore, the overall short-term effect of the fires was probably detrimental to moose populations, which continue to be monitored. Moose are more commonly observed in the park's southwestern corner and in the Soda Butte Creek, Pelican Creek, Lewis River, and Gallatin River drainages.

**Number in Yellowstone**

- 200–250

**Where to see**

- Summer: Lamar Valley.  
Spring, Fall, Winter: near the North Entrance near Gardiner, Montana

**History**

- Prior to European-American settlement of the West, pronghorn population estimated to be 35 million.
- Prior to the 19th century, pronghorn abundant in river valleys radiating from Yellowstone.
- Settlement and hunting in 19th century reduced their numbers.
- Park management also culled pronghorn during the first half of the 20th century due to overgrazing concerns.
- By 1967, fewer than 200 pronghorn were counted.

**Research Concerns**

- 1991, 594 counted; decline may be due to predations, in-breeding depression, and loss of winter range.
- Research began in 1998 to study mortality of this small population, which contains more genetic diversity than any other North American herd studied. Biologists believe that if the herd drops below 200 animals, it will be in jeopardy of extinction.

The North American pronghorn (*Antilocapra americana*) is not a true antelope (like gazelles), which are found in Africa and southeast Asia. The pronghorn is the only surviving member of a group of animals that evolved in North America during the past 20 million years. Use of the term “antelope” seems to have originated when the first written description of the animal was made during the 1803-1805 Lewis and Clark Expedition. Clark wrote, “He is more like the Antelope or Gazella of Africa than any other species of Goat [sic].”

The pronghorn has true horns, similar to those of bison and bighorn sheep. The horns are made of modified, fused hair that grows over permanent bony cores, but they differ from those of other horned animals in two major ways. First, the sheaths are shed and regrown every year; second, they are the only horns which have a fork (the prong) in them. (A number of other horned mammals occasionally shed their horns, but not annually.) Adult males (bucks) typically have 10- to 16-inch horns, which are curved at the tips. About 70 percent of the females (does) also have horns, but they are considerably smaller than those of males, averaging 1 to 2 inches long. The males usually shed the horny sheaths in November or December and begin growing the next year's set in February or March. The new horns grow for 9 to 10 months, reaching their maximum development in August or September. Females are quite variable as to when their unbranched horns are shed and regrown.

Even without their unusual horns, pronghorns are easy to distinguish from all other North American hoofed animals. Their deer-like bodies are reddish-tan on the back and white underneath, and they have a large white rump patch. They have very large and protruding eyes, which provide the animal with an extraordinarily large field of vision. Males have a black cheek patch, which is absent in the females. Pronghorns usually measure about 45 to 55 inches from the nose



tip to tail and are 35 to 40 inches tall at the shoulder. Males weigh about 100 to 125 pounds, and females weigh around 90 to 110 pounds.

During winter, pronghorns form herds that may contain dozens, or even hundreds, of animals of both sexes and all age classes. When spring arrives these congregations split into smaller bands of females, bachelor groups of males between 1 and 5 years old, and solitary older males. Yearling or older females that bred the previous fall commonly deliver a set of twins in May or June. The new-born kids are a uniform grayish-brown color and weigh between 6 and 9 pounds. They are able to walk within 30 minutes of birth and are capable of outrunning a human in a couple of days. The young normally stay hidden in the vegetation while the mother grazes close by. After the kids turn three weeks old they begin following the females during daily foraging. At this time several females and their youngsters join together in nursery herds along with yearling females.

Most likely, pronghorns form groups for increased protection against predators. Whenever one individual detects danger it flares its white rump patch, signaling the others to flee. The pronghorn is well adapted for outrunning its enemies, having an oversized windpipe and heart that allow large amounts of oxygen and blood to be carried to its unusually large lungs. Pronghorn can sustain sprints of 45 to 50 mph. Such speed, together with a keen visual “advance warning system,” make the adults difficult prey for any natural predator. Kids, however, are taken fairly often by coyotes, bobcats, and golden eagles. If adults are weakened by severe winter weather, they too will fall prey to these predators as well as to free-ranging dogs.

While the pronghorn’s speed frustrates most predators, running is no match for a tight fence. Pronghorns can jump over fences, but most are reluctant to do so. Instead, they would rather crawl under or through the barrier. Fences made of woven wire or four to five tight strands of barbed wire often will corral pronghorns and enable predators to capture them—especially if the antelope is slowed by deep snow. Also, such obstacles prevent pronghorns from moving readily to new food supplies or from migrating to sheltered areas during severe winters.

The pronghorn breeding season, or “rut,” commences in mid-September and extends through early October. During the rut the older males defend territories in areas having the best food supplies. They warn any intruding males with loud snorts and wheezing coughs. If this behavior does not scare off the opponent, a fight may erupt. The contenders slowly approach one another until the horns meet, which is followed by vigorous twisting and shoving. Eventually, the weaker individual will retreat. Although the fights may be bloody, fatalities are rare. Males reigning over the choicest territories may attract the largest number of female visitors and, thus, do most of the breeding.

A pronghorn’s day is divided between feeding, resting, and ruminating (“chewing its cud”), and includes trips to water holes if forage is very dry. The most important foods throughout the year are various shrubs like sagebrush and rabbitbrush; these shrubs become critical during winter when lower-growing plants are covered by snow. Succulent forbs are consumed during spring and summer. Pronghorns may actually benefit some rangelands by eating vegetation that is poisonous or unpalatable to livestock. They seem to relish plants like locoweed, lupine, and poisonvetch. It is thought that the pronghorn’s very large liver (proportionately, almost twice the size of a domestic sheep’s liver) is used to remove forage toxins, including selenium and various alkaloids, from the blood stream. Grasses appear to be the least-used food item, but may be eaten during early spring when the young and tender shoots are of high nutritional value.

During summer, nursery and bachelor herds may forage within home ranges of 1,000 to 3,000 acres while solitary males roam smaller territories (60 to 1,000 acres in size). In winter, home ranges are generally smaller. Pronghorns, including some in Yellowstone, also may migrate many miles between different winter and summer ranges, allowing them to more fully utilize forage within broad geographic areas.

During the early part of the nineteenth century, pronghorns ranked second only to bison in numbers, with an estimated 35 million throughout the West. The herds were soon decimated by conversion of rangeland to cropland, professional hunters who sold the meat, and ranchers who erroneously believed that pronghorns were competing with livestock for forage. By the 1920s, it was estimated that only 15,000 to 20,000 individuals were left on the entire continent. Today, due to transplant programs and careful management, pronghorns again roam the sagebrush prairies in herds totaling nearly one-half million animals.

Between 200 and 250 pronghorns live in Yellowstone National Park and adjoining lands. The best places to see them year-round are the grassy flats just south of Gardiner, Montana, and the area east of the park's horse corrals, 3 miles north of Gardiner along the county gravel road. In summer, pronghorns may be seen in Lamar Valley south of the Lamar Ranger Station. Historically, pronghorn migrated to the Hayden Valley during summers, but since the 1940s pronghorn are rarely seen in the park's interior.

There has been some concern that large declines in pronghorn numbers in the park, especially between the 1960s and 1980s, were caused by poor (overgrazed) range conditions. In 1991, park researchers began collaring pronghorn kids to monitor their movements and survival. Nearly all collared pronghorn kids were apparently killed by coyotes. The average kid life span in 1991 was about 35 days. This mortality rate closely followed the decline in total kid numbers measured during weekly surveys of the entire park. At least from this small sample, it appeared that natural predation, not range conditions, caused the loss of most the annual kid crop. Pronghorn population numbers have continued to decline, and in late 1998 another study was initiated to determine what the fawn productivity and mortality rates are.

There is also concern that the park's antelope herd is too small and too isolated to ensure its viability. In the winter of 1995-96, the park initiated weekly winter surveys of pronghorn between Mammoth and Cinnabar Mountain (north of Gardiner, Montana) in order to help track the trend in the pronghorn herd and its relationship, if any, to bison management-related activities near Stephens Creek. There was no bison control activity in the area in 1995-96. During 1996-97, significant bison management operations occurred, and preliminary data suggest that increased human activity may influence pronghorn distribution on their winter range.

## Bighorn Sheep

As of March 2000 . . .

### Number in Yellowstone

- 150–225
- Summer: slopes of Mount Washburn, along Dunraven Pass.  
Year-round: Gardner Canyon, between Mammoth and the North Entrance.

### Management

- Bighorns in Gardner Canyon exhibit some habituation to humans. Be alert to them along the road.
- Researchers from Montana State University are studying bighorn sheep habitat use and the effect of human activity along the Gardner–Mammoth corridor. About 65% of all sheep observations in this winter range were atop McMinn Bench, which has been proposed as an alternate route for the road. Moving the road to this location would affect at least 2 ewe groups and 2–3 ram groups.
- Early accounts that reported large numbers of bighorn sheep in Yellowstone have led to the speculation that they were more numerous before the park was established.
- The northern range population has not recovered to levels recorded before a *Chlamydia* (pinkeye) epidemic that broke out in the winter of 1982, resulting in the loss of about 60% of the herd. Since no sign of the disease is currently present, other factors are believed to be limiting the bighorn sheep population, such as over-hunting outside the park, introduction of other domestic livestock diseases, and difficulty in re-colonizing previous habitats.
- The cliffs in the Gardner Canyon, between Mammoth Hot Springs and the park's north entrance, are closed to human entry to protect the sheep, which use these cliffs for shelter, security, water, and minerals.

Bighorn sheep (*Ovis canadensis*) once numbered in the millions in the western United States. But, by 1900, bighorn numbers were reduced to a few hundred due to intense market hunting. The bighorn was the principal food of the “Sheepeaters,” a band of the Shoshone tribe who lived year-round in Yellowstone until 1880. The Sheepeaters also made their bows from sheep horns.

In 1897 naturalist Ernest T. Seton spent several months roaming the upper ranges of Yellowstone National Park and did not see any sheep, although about 100 to 150 were estimated to be present. Later, in 1912, Seton reported that despite a disease (scab) contracted from domestic sheep, bighorns in the park had increased to more than 200, and travelers could find them with fair certainty by devoting a few days to searching around Mt. Everts or Mt. Washburn. In the winter of 1981–82, an outbreak of pinkeye occurred among bighorns in the Mt. Everts area. Many sheep were blinded and/or killed on the adjacent park road or by falling from cliffs. No evidence of the disease, a natural occurrence, has been found since. The current population of bighorn sheep is estimated to be 150–225 animals.

Bighorn sheep inhabit high, rocky country. Both males (rams) and females (ewes) have horns, but they are shaped differently. Those of the male are large and curved while those of the female are slightly curved, slender, and much smaller. The body hair is straight, not woolly. Bighorn sheep are tan brown in summer and much lighter in winter.

Mating season begins in November. Males challenge one another in dramatic battles, snorting and grunting and rising onto their hind legs, then racing toward each other and loudly crashing their heads and horns together. Their extra thick skull protects their brain during these jarring

encounters. Occasionally one male butts another one over a cliff. By the time the two-month mating season is over, males are often battered and bruised.

One or two lambs are born in late spring and grow rapidly. When first born, lambs can walk under a standing ewe, but within a month they must kneel to nurse. All bighorn sheep are extremely sure-footed. The bottoms of their feet are concave, enabling them to walk and run over rocks very easily.

For the first two years of its life, the horns of a male are similar to the small horns of a female. But by the time a male is five years old the horns have grown until they reach the bottom of the downward swing. When a male is six or seven years old, the horns form the better part of a circle. The bone interior of the horn does not extend out very far; the outer parts of the horns are hollow and may be damaged during the rut. Broken or splintered tips are never replaced, and the horn continues to grow from the base throughout the animal's life.

Forage consists of mountain grasses, herbs, and some woody plants. As the animals feed, one acts as a sentinel. At any hint of danger, all take off after the leader, generally a female, and do not stop until they have climbed as high as they can go or passed to the other side of the mountain. The bighorn swims well and often plunges into rivers or lakes to move from a summer feeding ground to a wintering area.

In summer, sheep are found in the Gallatin, Washburn, Absaroka, and Red mountain ranges. On Dunraven Pass, between Canyon and Tower Junction, a band of ewes and lambs has become somewhat habituated to summer traffic. These bighorns cause numerous traffic jams and are sometimes illegally fed by visitors, posing traffic hazards and danger to the sheep.

### **Mountain Goats**

Visitors occasionally inquire about the presence of the mountain goat (*Oreamnos americanus*) in Yellowstone. This distinctive, snow-white mammal has been sighted in the northwestern and northeastern corners of the park and in the Gibbon River Canyon in recent years. Goats are not native to Yellowstone, but no decision has been made about what to do if goats become established here.

## Mountain Lions

As of March 2000 . . .

### Number in Yellowstone

- 18–24 on the northern range; others in park seasonally.
- Mountain lions occupied Yellowstone since the park's establishment in 1872. Populations were significantly reduced by predator control measures during the early 1900s. It is reported that 121 lions were removed from the park by 1925, at which time the population was estimated at 12 individuals.

### Where to see

- Seldom seen.

### Research

- In 1987, the first study on mountain lions in Yellowstone documented population dynamics in the northern Yellowstone ecosystem. In 1998, research began to assess effects of wolf restoration on mountain lions.

### Other Info

- Preferred terrain: rocky breaks near prey.
- Prey: primarily elk and deer; sometimes moose, bighorn sheep, porcupine, other small animals.
- Bears frequently displace cougars from their kills.
- In the winter of 1999–2000, wolves apparently killed or caused the abandonment of 4 kittens in one litter.
- Mountain lions, especially males, kill other cougars within their territory.

### Interaction with humans

- No documented lion-human confrontations have occurred in Yellowstone.
- Report all sightings.
- Preventive and defensive measures: grouping together or - carrying small children; and making noise, waving arms, throwing rocks or sticks if necessary to scare off a big cat if close or stalking humans.

The mountain lion (*Felis concolor*), also called the cougar, is the largest member of the cat family living in Yellowstone. Mountain lions can weigh up to 200 pounds, although park lions are thought to range between 140 and 160 pounds for males and around 100 pounds for females. Two to three kittens may be born at any time of year, although most arrive in summer and fall. For reasons that are not clear, only about 50 percent of kittens survive their first year. The current population of lions in Yellowstone is estimated at 18–24 animals and is thought to be increasing.

Mountain lions are rather secretive, consequently, most visitors are unaware of their existence in Yellowstone. Lions probably live throughout the park in summer. In winter, difficulty of movement and lack of available prey causes most lions to move to lower elevations. Lions are territorial and will kill other lions. The dominant animals reside in the northern range areas of the park where prey is available year-round. Mountain lions prey chiefly upon elk and deer, although their diet probably varies based upon opportunity. In winter, porcupines provide an important supplement to the lion's diet.

Mountain lions were significantly reduced by predator control measures during the early 1900s. It is reported that 121 lions were removed from the park between the years 1904 and 1925. At that

time, the remaining population was estimated to be 12 individuals. Mountain lions apparently existed at very low numbers between 1925 and 1940. Reports of lions in Yellowstone have increased steadily from 1 each year between 1930 and 1939 to about 16 each year between 1980 and 1988. However, increases in visitor travel in Yellowstone and improvements in record keeping during this period probably contributed to this trend.

In 1987, the first study of mountain lion ecology was initiated in Yellowstone National Park. The research documented population dynamics of mountain lions in the northern Yellowstone ecosystem inside and outside the park boundary, determined home ranges and habitat requirements, and assessed the role of lions as a predator in the ecosystem. In recent years in other areas of the West, mountain lions have occasionally attacked humans. No documented lion/human confrontations have occurred in Yellowstone.

## Coyotes

As of March 2000 . . .

### Number in Yellowstone

- Numerous. However, since wolves were reintroduced to Yellowstone in 1995, the coyote population has decreased 30–50% through direct mortality and changes in coyote denning behaviors and success.

### Where to see

- Meadows, fields, other grassland areas

### Management

- Like other predators, coyotes were often destroyed in the early part of the 20th century because they were thought to prey on livestock.
- Coyotes continued to thrive because their adaptability enabled them to compensate for the destruction efforts.
- Elimination of wolves probably resulted in high coyote population densities and opened a niche that coyotes could occupy in Yellowstone.
- In 1989, researchers began investigating the basic ecological role of coyotes in Yellowstone. The park is one of the few places where the natural behavior of coyotes is not strongly influenced by trapping or predator-control programs. Yellowstone is one of the few places in North America where coyotes live in packs.
- Coyotes can lose their wariness of humans if they are conditioned to accept human food.
- Several instances of coyote aggression toward humans have occurred in the park.
- NPS staff monitors coyotes and use cracker-shell rounds, bear spray, or other negative stimuli to aversively condition them.

Coyotes (*Canis latrans*) are intelligent and adaptable. The coyote is respected by many Native American tribes and is often portrayed in their various legends as a teacher and/or trickster. For the Euro-American settler, however, coyotes were viewed as a serious problem. Like the wolf, when the wild game in an area was gone, domestic animals became prey. However, owing to its greater adaptability, coyotes were—and continue to be—successful in resisting efforts to exterminate them. The coyotes of Yellowstone were originally blamed for serious wildlife losses until the results of careful research in the 1940s proved differently. This research showed that the chief foods of the coyote are marmots, voles, mice, rabbits, and other small animals as well as carrion.

The coyote is a rather small, slender animal resembling a shepherd dog in general appearance. While most appear rather tan in pelage, coats are sometimes buffy, grayish and black, or yellowish in some individuals, with underparts lighter, and a large and bushy tail. Males are slightly larger than females. Adults average about 35 to 45 pounds, total length is 3 to 4 feet, and height at the shoulder is 16 to 18 inches. Yellowstone's coyotes are among the largest coyotes in the United States, and visitors frequently mistake them for wolves. Five to seven pups are born in April in a small cave, cavity among rocks, or ground burrow. By August, they appear full grown and are hunting in family groups.

In 1989, research was undertaken to investigate the basic ecological role of coyotes in Yellowstone. The park is one of the few places where the natural behavior of coyotes is not strongly influenced by trapping or predator-control programs. Yellowstone is one of the few places in North America where coyotes live in packs; 85 to 90 percent of coyotes on the northern range belong to packs. Researchers captured and radio-collared coyotes, mainly on Yellowstone's northern range, in order to study movements and behavior. Males and females were sampled from at

least 16 different resident packs. Average pack size during the winters of 1990-93 was 6 to 7 animals, and the pack typically consisted of a dominant, mated “alpha-pair” and subordinate “beta” individuals. The betas are pups from previous litters that remain in the area where they were born. Evidence strongly indicates that coyote territories are traditional.

Wolf extirpation probably resulted in high coyote population densities, and coyotes, at least partially, slid into the niche left vacant by the removal of wolves. The northern Yellowstone coyote population has characteristics similar to those of gray wolves: low productivity, a highly structured social system, non-overlapping year-round territories, and an old age structure. Adult mortality is very low and is primarily due to vehicles and mountain lions. Dozens of fatal wolf-coyote interactions have been documented in the first years of wolf restoration to the park. On the northern range, researchers estimate that wolves have caused up to a 50 percent reduction in the resident coyote population through direct mortality and changes in coyote denning behaviors and success.

Coyotes occasionally lose their wariness of humans and frequent roadsides or developed areas, becoming conditioned to human food by receiving handouts or picking up food scraps. They can quickly learn bad habits like roadside begging behavior. This leads to potential danger for humans and coyotes. Several instances of coyote aggression toward humans have occurred here, including one that involved an actual attack. Habituation most likely played a role in this unusual coyote behavior.

Beginning in 1988, park staff increased monitoring of coyotes along park roadsides and began to experiment with scaring unwary coyotes from visitor-use areas with cracker-shell rounds, bear repellent spray, or other negative stimuli. Those animals that continue to pose a threat to themselves or to humans are translocated to other areas of the park or removed from the park ecosystem. Signs, interpretive brochures, and park staff continue to remind visitors that coyotes and other park wildlife are wild and potentially dangerous and should never be fed or approached.



## Beaver

As of March 2000 . . .

### Number in Yellowstone

- Approximately 300

### Where to see

- Beaver are distributed throughout Yellowstone, though not uniformly. They are concentrated in the southeast (Yellowstone River delta), southwest (Bechler River), and northwest (Madison and Gallatin rivers) areas in the park. However, since they are most active at night, beaver are not commonly seen

### Other Info

- By the early 1800s, fur trappers had nearly decimated beaver populations in the American Northwest to supply pelts for men's beaver hats in Europe. Since Yellowstone was hard to get to and there was not an abundant quantity of beaver in the area, Yellowstone's beaver were never "trapped out."
- In recent years, some park critics have insisted that beaver have been extirpated from the park. Park records show beaver present throughout Yellowstone's history.

### Current Management

- Since 1989, park staff has periodically surveyed riparian habitats for beaver. A 1998 survey flight counted 51 lodges with an associated food cache, and offered an estimated population of about 300 beaver. A 1999 flight documented even more active colonies; results from this and a corresponding 1998 ground survey are still being analyzed.

While Yellowstone National Park has many rare and wonderful forms of wildlife, none has been as important to the human history of this continent as the beaver, *Castor canadensis*. A fad in European men's fashion in the 1700s and early 1800s led to the era of the fur trapper/mountain man in the North American West. The introduction of silk in the late 1830s brought about a change of fashion—and likely saved the beaver from extinction. While Yellowstone's beaver were trapped on occasion, they received nowhere near the attention that beaver in other mountainous regions did. Yellowstone was a difficult place to get to in those early days, and trappers quickly found out that there was not an abundant quantity of pelts in this area, as Yellowstone is near the limits of beaver range. Because of these two reasons, Yellowstone's beaver were never "trapped out" (extirpated).

Beaver live in groups, or colonies, and they are almost always found in or near water. Beaver are about 35 to 40 inches long, with the last 10 inches being a paddle-shaped tail. When startled or surprised, beaver slap their tail on the water before submerging and seeking safety. With an average weight of 30 to 60 pounds, the beaver is the largest rodent of North America. Rich brown in color, beavers have no sexual dimorphism; that is, male and female appear exactly alike in all respects. Because beaver are most active at night, it is not likely that visitors will see beaver in Yellowstone.

While famous as "dam builders," not all beaver colonies build dams. Most dams are on small streams where the gradient is mild, and the current is relatively placid during much of the year. Colonies located on major rivers or in areas of frequent water level fluctuations (such as the Yellowstone River, Lamar River, or the Snake River in the park) do not build dams on the main waterways; however, beaver persist in these major rivers, often denning in holes in the riverbank rather than in the well-known lodges.

Beaver are distributed throughout Yellowstone National Park, although not uniformly. Beaver are concentrated in the southeast (Yellowstone River delta area), southwest (Bechler area), and north-west portions (Madison and Gallatin rivers) of the park. These areas are likely important habitat due to the amount of water present, the meadow-type flatlands, and the associated extensive willow communities present. In the lower Madison and Gallatin river drainages, aspen communities are more extensive than elsewhere in Yellowstone.

While willows, aspens, and/or cottonwoods are generally preferred beaver foods, there is wide regional variation in the number and composition of woody plant species utilized by the animal, and it should be noted that beaver are not restricted to riparian types of habitat. Essentially no aspen exists in some areas where beaver sign is most abundant, such as in the Bechler River and Boundary Creek areas. The same is true in other areas where beaver appear to persist, although sign is less abundant and/or more dispersed. These areas include Heart Lake, Grizzly Lake, the lower Lamar River and Slough Creek area, the Beaver Ponds near Mammoth, Slide Lake, and the lower Gardner River. In areas of this nature, beaver appear to use lodgepole pine and some Douglas-fir for construction purposes and/or for food. Beaver are known to eat the cambium from pines. The beaver's digestive system allows it to digest the most nutritious parts of a large amount of woody, fibrous plants. In areas where preferred woody plants are only present in very small densities or are absent, beavers may feed solely on submerged vegetation.

Since 1989, park staff have periodically surveyed riparian habitat in Yellowstone to determine current presence and distribution of beaver. These surveys encompassing more than 250 miles of riparian habitat, including more than 75 lakes and stream segments in the five major drainages of Yellowstone. During the 1994 survey, 113 beaver dams were observed as were 78 lodges, of which 44 (56 percent) appeared to be active. Researchers have long known that areas that appear to be marked by "old" beaver activity may still be active, and beaver often reoccupy lodges that were abandoned in past years. An example of this was seen at Slide Lake, near Mammoth. A lodge that was occupied during the 1988-89 survey appeared partially collapsed and abandoned during initial observations in 1994. About one month later, however, a large adult beaver was seen using this lodge.

Beaver do not necessarily avoid areas that received moderate to high levels of human use. Several occupied lodges in Yellowstone are in close proximity to popular backcountry trails and/or campsites. Also, several beaver sightings occur along main park roadways every year. The nocturnal habits of beaver seem to be enough to separate them from human use of the same area.

## Birds

As of March 2000 . . .

### **Number in Yellowstone**

- 303 bird species have been documented in Yellowstone.
- 148 of these species nest in the park.

### **Other Info**

- One endangered bird species occurs in Yellowstone; the whooping crane. The peregrine falcon, formerly an endangered species, was de-listed in August, 1999.
- One threatened bird species occurs in Yellowstone; the bald eagle.
- Other species of concern include: peregrine falcons, American white pelicans, trumpeter swans, ospreys, common loons, harlequin ducks, great blue herons, great gray owls, and colonial nesting birds.

### **Current Management**

- Yellowstone is an active participant in the Western Group of Partners in Flight, an international effort to protect migrant land birds in the Americas, because more than 100 of its bird species spend the winter in Mexico and Central America. There, they are threatened by loss of habitat, pesticide use, hunting, and an increase in human development.

Records of bird sightings have been kept in Yellowstone since its establishment in 1872; these records document 303 species of birds, of which 148 are known to nest. This is quite remarkable, especially when one considers the harsh environmental conditions that characterize the area. Winters are long in Yellowstone, and snow can fall in any month of the year. Although elevations range from about 5,300 feet to more than 11,000 feet, the majority of the park is a high plateau lying between 7,000 and 8,000 feet.

Habitats vary considerably in the park, from low elevation sagebrush grasslands to high alpine tundra. However, the majority of the park is forested, mainly with lodgepole pine. There are many lakes and streams in Yellowstone that afford riparian habitat as well as areas of spruce-fir and Douglas-fir forest. Many birds, such as robins and common ravens, are found throughout the park. Other species are localized in particular habitats. For example, belted kingfishers are found near rivers and streams while Steller's jays are found in coniferous forests.

Spring migration brings many birds back to Yellowstone from their winter journeys south. This is a good time to look for birds. Birds are singing now to establish and defend their territories, and they are in their distinctive, colorful breeding plumages, which makes identification easier. Watch for birds on early morning walks from mid-May through early July. At all times, but especially during the nesting season, birds should be viewed from a distance. Getting too close can stress a bird (as it can any animal) and, sometimes, cause the bird to abandon its nest. Most birds migrate to lower elevations and more southern latitudes beginning in September. Some birds do stay in Yellowstone year-round, including the common raven, Canada goose, blue grouse, gray jay, red-

breasted nuthatch, and American dipper.

There are a number of interesting birds that many visitors may see while in Yellowstone. American white pelicans are often seen along the shores of Yellowstone Lake and in the Yellowstone River. These large white birds are often mistaken for trumpeter swans until their huge yellow beak and throat pouch is seen. In flight, the black tips of their wings are easily visible. A common visitor question is, "What is the black and white bird with the long tail?" It is the black-billed magpie, a gregarious bird seen throughout the West, often along the highway. The osprey, or "fish hawk," is often seen along rivers and at the Grand Canyon of the Yellowstone (where six to ten pairs have nested since the mid-1980s). In flight, the osprey's white underparts, narrow wings with a bend and dark patch at the wrist are good identifiers. While many people hope to see the elusive great gray owl, few do. These secretive birds are found in dense forests. Many sightings in Yellowstone have been in the Canyon area.

With steaming geysers, shining mountains, tremendous herds of bison and elk, the celebrated grizzly bear, and, now, the wolf to attract one's attention, Yellowstone's birds are often overlooked. But, the rewards for the birder in Yellowstone are great. From the common to the unusual, Yellowstone's birds draw your eye to places and scenes that might be missed without the motion and color of these feathered residents. The park's bird list (Field Checklist of Birds of Yellowstone National Park 1996) is available at park visitor centers.

### **Bald Eagles**

The bald eagle (*Haliaeetus leucocephalus*) is a large, brown-bodied bird with a completely white head and tail. Females are larger than males, which is true with most predatory birds. Eagles form long-term pair bonds. Immature eagles will appear mostly brown although nearly full-sized by their first winter. They change their coloration several times before achieving their adult colors when about five years old. Immature bald eagles are often mistaken for golden eagles. (Sometimes a good way to determine which bird is being observed is to note the habitat the bird is seen in. Bald eagles feed on fish and waterfowl and are almost always observed near water while golden eagles hunt in open country.)

Bald eagles reside in Yellowstone throughout the year, nesting in large trees in close proximity to water. In winter, fish stay deeper in water and are more difficult for eagles to catch. Waterfowl then comprise more than half an eagle's diet; carrion is used whenever it is available. During severe winter weather, some eagles may move to lower elevations where food is more available. On these wintering areas, resident eagles may be joined by migrant bald eagles as well as golden eagles.

By late winter, eagles are returning to their nesting sites; eagles are extremely sensitive to human disturbance when nesting. One to three eggs (usually two) are laid in late March to mid-April. Both eagles incubate the eggs, which hatch in 34 to 36 days. At birth, eaglets are immobile, downy, have their eyes open, and are completely dependent upon their parents for food. By 70 to 98 days after hatching, they fly from the nest. Radio-tagging studies have shown that all young produced in a given summer leave the park in fall although most of the adults stay in the park. Some young Yellowstone eagles migrate to western Oregon and Washington their first fall.

The bald eagle is listed as "threatened" on the Endangered Species List, but recovery appears to be well underway. As of 1989, recovery objectives had been reached in the greater Yellowstone ecosystem as well as in the Pacific Northwest region. In 1995, the U.S. Fish and Wildlife Service downlisted the bald eagle from "endangered" to "threatened" in four of five regions, including the one containing Yellowstone, due to the significant population gains made.

In Yellowstone, there were 22 active eagle territories in 1998, and 15 eaglets fledged. Some eagle territories are experiencing nest instability due to the large number of trees that are falling as a result of the 1988 wildfires. Collectively however, bald eagles are doing very well in the park and throughout the greater Yellowstone ecosystem.

### **Peregrine Falcons**

In 1962, Rachel L. Carson sounded an alarm concerning the irresponsible use of pesticides in our environment with the landmark book, *Silent Spring*. Among other dangers, she pointed out the

adverse effects of chemicals on the reproductive capacity of some birds, especially predatory species. Among those birds that were affected was the peregrine falcon (*Falco peregrinus*). The peregrine was on the Endangered Species List, but it has made a comeback in much of its former range and was delisted in 1999. The most damaging pesticides were banned, and a program of reintroduction by groups such as the non-profit Peregrine Fund of Boise has led to this success.

Young peregrine falcons were released in Yellowstone between 1983 and 1988. The reintroductions were discontinued after 1988 when it became evident that the population of peregrines was increasing on its own. Peregrine falcons reside in Yellowstone from April through October, nesting on large cliffs that overlook rivers or valleys where prey is abundant. Their food is mostly song-birds and waterfowl. Peregrines winter as far south as South America; none of them spend the winter in Yellowstone.

The peregrine is difficult to observe. Because of their great speed and low population numbers, sightings in Yellowstone are rare. The peregrine is slightly smaller than a crow and has a black “helmet” and a black wedge below the eye. The prairie falcon, often confused with the peregrine, has black “armpits” under its wings. Peregrines are expert hunters and have been clocked at speeds exceeding 200 mph in dives after prey.

In Yellowstone, known peregrine nesting sites (eyries) increased from 1 in 1984 to 13 in 1998. In 1998, 22 young peregrines fledged from 13 eyries. Biologists believe that the peregrine falcon is ecologically recovered in Yellowstone, as elsewhere. However, because peregrines are highly prized by falconers, the locations of nesting sites are not revealed.

### **Trumpeter Swans**

The trumpeter swan (*Cygnus buccinator*) is the largest wild fowl in North America. The long-necked swan is all-white and has a black bill. Both males and females are about equally sized; on average, an adult male weighs 25 to 30 pounds and a female about 20 to 25 pounds. They are most often observed swimming in slow-moving rivers or placid lakes. While their normal life span is not known, there is a record for one individual living 23 years and 10 months.

Common in North America at one time, trumpeter swans in the lower 48 states neared extirpation in the early 1900s as a result of human encroachment, habitat destruction, and the commercial swan-skin trade. A small population of swans survived in Yellowstone and in other isolated areas of the country. Swans received protection when the Migratory Bird Act of 1918 was passed. Red Rock Lakes National Wildlife Refuge, the country’s largest mountain-marsh ecosystem, was set aside in the 1930s specifically for the trumpeter. In the 1950s, a sizeable population of swans was discovered in Alaska. Today, some 10,000 trumpeters exist in North America.

In Yellowstone, the resident population of swans rarely exceeds 30, and winter numbers vary between 60 to several hundred swans. Swan reproduction rates are low, and populations have fluctuated dramatically in Yellowstone. Predation and weather appear to be the primary factors influencing production here. Lack of recruitment from outside the park is also of concern. Overall, in the greater Yellowstone area, the number of resident swans is low perhaps 300 to 400 year-round residents and in excess of 2,000 winter migrants, and each location occupied by swans has its own set of inherent problems.

Non-native swans (mute swans), especially those in the Paradise Valley of Montana (north of the park), are a potential threat to the trumpeters in Yellowstone. In cooperation with specific local landowners, mute swans on private lands are replaced with captive-raised trumpeter swans to reduce the threat of non-native birds.

Trumpeter swans are most often seen on the Madison River at Seven Mile Bridge on the West Entrance Road and occasionally at Swan Lake. Human disturbance of a nesting site is a common cause of failure to hatch cygnets, and signs at the Madison River site warn visitors to keep a respectful distance. In order to try to mitigate the effects of human interference, a floating nesting platform exists out in the reeds at Seven Mile Bridge. Although this platform is used by swans, the status of the swan population in the park is precarious. In 1998, there were nine nest attempts but only three cygnets were counted in the fall along with 20 adult birds.

**Number in Yellowstone**

- Natives—12
- 3 sport fish: cutthroat trout (3 races), Arctic grayling, mountain whitefish
- 5 minnows: longnose dace, speckled dace, redbase shiner, Utah chub, redbase shiner/speckled dace hybrid
- 3 suckers: longnose sucker, mountain sucker, Utah sucker mottled sculpin
- Non-native—5 species: brook trout, brown trout, lake trout, rainbow trout, lake chub

**History**

- Many waters in Yellowstone were fishless when the park was established.
- Stocking of native and non-native fish occurred for decades to accommodate the growing popularity of sport-fishing.
- Problems with stocking:
  - 1) Changed the ecology of many Yellowstone waters, especially as non-native fish displaced or interbred with native species, diluting their genetic makeup.
  - 2) Affected the quality of the fishing experience, because the abundance of fish attracted so many anglers that, even with continual restocking, the annual trout harvest could not be sustained.

**Status**

- By the 1960s, Yellowstone's fish populations were in poor condition and the angling experience had declined, prompting a major change in fisheries management.
- By the late 1980s, Yellowstone's native trout had recovered under angling restrictions that still provide opportunities for visitors to catch wild fish in a natural setting, but discourage the killing of fish.
- Threats to the fisheries:
  - 1) Three species at risk of extinction: fluvial Arctic grayling, upper Missouri morph of the westslope cutthroat trout, finespotted cutthroat trout.
  - 2) Lake trout illegally introduced into Yellowstone Lake, creating a new threat to the Yellowstone cutthroat trout.
  - 3) Whirling disease is now present in Yellowstone Lake, posing another threat to the native cutthroat.
  - 4) New Zealand mud snail disturb fish populations and the natural functioning of the ecosystems.

More than 220 lakes comprise approximately 107,000 surface acres in Yellowstone—94 percent of which can be attributed to Yellowstone, Shoshone, Lewis, and Heart lakes. Some 1,000 streams make up more than 2,650 miles of running water. When explorers first visited the park, about 17 lakes contained endemic fish populations and 135 were barren. It is believed that about 40 percent of all waters in Yellowstone were barren when the area was made a national park, including the upper Firehole River, Shoshone Lake, and Lewis Lake. Early in the park's history fish were transplanted into new locations, intensively managed at hatcheries, and non-native species introduced. Between 1881 and 1980, more than 310 million fish were stocked in Yellowstone. Today, about 40 lakes have fish populations; the remainder were either not planted or have restored themselves to an original barren condition.

Despite changes in species composition and distribution, large-scale habitat degradation has not occurred in the park. Water diversions, water pollution, and other such impacts on aquatic ecosystems have rarely occurred here. Thus, Yellowstone contains one of the most significant, near-pristine aquatic ecosystems found in the United States. Predators on fish include threatened grizzly bears, endangered bald eagles, black bears, otters, mink, ospreys, pelicans, loons, grebes, mergansers, diving ducks, terns, gulls, kingfishers, and herons.

There are 12 species of fish native to the park, including Arctic grayling, westslope and Yellowstone cutthroat trout, mountain whitefish, three species of suckers (Utah, longnose, and mountain), four species of minnows (longnose dace, speckled dace, redbase shiner, and Utah chub), a hybrid minnow (redside shiner/speckled dace), and the mottled sculpin. Their ranges and densities have been substantially altered during the past century due to exploitation, introduction of exotic species, and natural factors. Non-native species in the park include rainbow trout, brown trout, brook trout, lake trout, and lake chub. All non-native trout have become very important to the angler experience.

The history of fisheries management in Yellowstone began in the 1880s when non-native fishes were introduced into fishless waters (1881-1909). This period was followed by "put, grow, and take" practices for both native and non-native species (1920-1955). After 1955, the emphasis was on restoration and preservation of native species, subspecies, and genotypes, and there were major revisions in fisheries regulations and management. For about 30 years until 1996, the U.S. Fish and Wildlife Service maintained an office and staff in the park for the purpose of providing assistance with aquatic research and monitoring programs. For many years, the objectives of fisheries management in the park have been to manage aquatic resources as an important part of the park ecosystem, preserve and restore native fishes and their habitats, and provide anglers with the opportunity to fish for wild fish in a natural setting.

About three million visitors come to Yellowstone each year; approximately 17 percent of these visitors are anglers. Although about 100 waters are commonly fished, 96 percent of the angling is concentrated on 9 waters. Angling is an obvious anomaly in a park where the primary purpose is to preserve natural environments and native species in ways that maintain natural conditions. As in many other parks, it is often pointed out that consumptive use of the fishery resource contradicts policies that prevent harvest of other animals, trees, or minerals. Yet fishing has been a major visitor activity here for more than 100 years. Fly fishing is a major industry in the greater Yellowstone ecosystem, and park anglers spend more than \$4 million annually. Angler groups have supported management actions, such as closing the Fishing Bridge to fishing in the early 1970s, and have helped fund research on aquatic systems.

Observing fish in their natural habitat is obviously a popular activity even for non-anglers. Park staff monitored non-consumptive use of aquatic resources for about a decade (ending in 1992) at Fishing Bridge and LeHardy Rapids. The total number of visitors each year to LeHardy Rapids, where spawning cutthroat can be observed jumping the rapids, was about 134,000. Visitors at Fishing Bridge, where fish can be seen in the waters below the bridge, was nearly 290,000 in 1988.

### **Cutthroat Trout**

The cutthroat trout (*Salmo clarki*) is a relative of the salmon. Indeed, the flesh of the cutthroat is a pinkish-orange color. The fish is native to the Rocky Mountains, and, in Yellowstone, it occurs as three subspecies: the Yellowstone cutthroat, the Snake River cutthroat, and the westslope cutthroat

(see section below for details about this subspecies). The difference between the first two subspecies is in the size and number of the black spots on the fish. The Yellowstone cutthroat originally occurred in the Yellowstone, Madison, and Gallatin river drainages, but has since been planted in the southern part of the park. The Snake River cutthroat is limited to the Snake River drainage in the southern third of the park.

While the cutthroat is essentially a Pacific drainage species, it has (naturally) traveled across the Continental Divide into the Atlantic drainage. One possible interconnection between the two oceans in the Yellowstone area is at Two Ocean Pass (just south of the park in the Teton Wilderness Area). Here, a fish can literally swim across the Continental Divide at the headwaters of Pacific Creek and Atlantic Creek and, thus, swim from the Pacific Ocean to the Atlantic Ocean via the Snake and Yellowstone rivers. Two Ocean Pass was discovered (probably) by Jim Bridger around 1830. It was widely considered just a fable until it was rediscovered in 1873 by Captain W.A. Jones.

Cutthroat trout are abundant in Yellowstone Lake, and, for many years, intensive monitoring and research studies of the fish have been done on Yellowstone Lake. In the 1960s, it was determined that angler harvest was excessive and was having a negative impact on the fishery. In the 1970s and 1980s, increasingly restrictive angling regulations were put into place. Cutthroat trout population numbers and the age structure of the population were restored. The average fish taken from Yellowstone Lake weighs one pound and is about 14 inches long.

Cutthroats spawn in rivers or streams in late May through mid-July, and spawners are an important food resource for other Yellowstone wildlife species, including the grizzly bear. Yellowstone Lake and Yellowstone River together contain the largest population of native cutthroat trout in this hemisphere. The recent discovery of the illegally introduced lake trout in Yellowstone Lake now poses a significant threat not only to the future of the cutthroat trout population, but also to the bird and mammal species that depend on cutthroats as a food resource.

### **Westslope Cutthroat Trout**

Westslope cutthroat trout (*Salmo clarki lewisi*) were historically distributed throughout the Madison and Gallatin river drainages, but have since been reduced to small headwater populations as a result of habitat loss, overfishing, and competition from non-native fish. In an attempt to re-establish westslope cutthroat trout populations, candidate streams within their historic range were surveyed. Among those sites selected as potentially viable was Canyon Creek, a tributary of the Gibbon River that enters approximately 1/2 mile below Gibbon Falls.

Initial work began in July 1997 and focused on the removal of non-native fish from Canyon Creek through electrofishing methods. Introduced non-natives appear to be most responsible for the decline in range of westslope cutthroats as other factors such as habitat loss and pollution appear negligible in the park. From mid-July through October, approximately 5,000 brown, brook, and rainbow trout were removed from Canyon Creek and placed in the Gibbon River drainage. Additionally, an existing artificial fish barrier was improved to prevent non-natives from re-entering the stream. Following completion of the barrier, fish, particularly brown trout, were observed congregating below the barrier in an attempt to spawn in Canyon Creek. Although fish attempted to ascend over the barrier, none were successful.

As part of the restoration program, park staff are also searching for genetically pure populations of westslope cutthroat trout that remain within park boundaries. The presence of non-native fish (namely rainbow trout) and transplanted Yellowstone cutthroat trout have resulted in interbreeding of the three species and in the isolation of populations of unknown genetic structure. Fish surveys were conducted in small headwater streams in the northwestern portion of the park, including Fan, Specimen, and Grayling creeks. Tissue samples will be used for DNA analysis to identify genetically pure or hybrid individuals. If a genetically pure population is identified, information will be gathered to determine if those populations are a viable source of fish for current and future restoration efforts within the park.

### **Arctic Grayling**

The fluvial (riverine) Arctic grayling (*Thymallus arcticus*) is a rare and protected species in the



park. In 1993, the park began a cooperative program with the state of Montana to restore fluvial grayling to park waters by releasing 800 young fish. This restoration effort continued in 1994 and 1995, but has not been successful due to low over-winter survival, probably a result of poor quality habitat. Other ways to try to restore fluvial grayling in the upper Gallatin River drainage are being discussed.

### **Problems**

**Lake Trout.** In July 1994, non-native lake trout were discovered in Yellowstone Lake. Despite the extensive human influence on the Yellowstone Lake fishery during the past century, the native cutthroat trout population had never before been threatened by a larger predatory fish. Because of their size and voracious nature, lake trout, if left unchecked, could easily decimate the cutthroat trout population in Yellowstone Lake. Lake trout also threaten to disrupt the lake ecosystem because they are deep water spawners and spend much more of their life in deeper waters out of reach of the ecosystem predators that depend on cutthroat trout. Please see Chapter 8 for more information.

**The New Zealand mud snail** (native to New Zealand) was discovered in park waters in 1995. At present, the tiny (< inch), black, conical-shaped snail occurs in the Firehole, Gibbon, Madison, and Snake rivers, sometimes in extremely high numbers. The mud snail often forms dense colonies on aquatic vegetation and rocks along streambeds, crowding out native aquatic insect communities, which are a primary food source for fish. Strategies for dealing with this invader are being developed. In the meantime, anglers and other water users should rinse mud, plants, and debris from all angling gear, footwear, boats, pets, and other items used in the water before entering Yellowstone and after leaving each water body within the park. All gear should be thoroughly inspected for the mud snail.

**Whirling disease** is a parasitic infection of fish caused by a microscopic protozoan that destroys the cartilage of juvenile trout, causing them to swim in a whirling pattern (as if chasing their tail) when startled. Seriously infected fish have a reduced ability to feed or escape from predators, and mortality is high. Please see Chapter 8 for more information.

**The zebra mussel** poses another potential threat. It was first discovered in the United States in 1988. It is not now known to be in Yellowstone, but has been found in 18 states and 2 Canadian provinces. This jelly bean-sized animal is moving up the Missouri River drainages and may hitchhike on dirty boat hulls.

### ***Fishing in Yellowstone National Park***

In national parks where native plants and animals and natural environments are protected, there has been discussion of prohibiting fishing. Because fishing in Yellowstone is historically entrenched (since 1870) and not easily eliminated, it is allowed under strict regulations. These regulations are designed to allow ecological processes to function without interference from humans and to preserve fish populations first for the birds and animals that depend on them. Fish-eating birds (for example, pelicans, osprey, bald eagles, kingfishers, mergansers, gulls, terns, herons) on Yellowstone Lake consume approximately 200,000 pounds of fish each year. Other creatures that eat fish include river otter, mink, and bear.

Prior to 1994, a non-fee permit was required to fish in Yellowstone. Since 1994, a special-use permit is required to fish. A 7-day permit currently costs \$10 for anglers aged 16 and over, or anglers can purchase a season permit for \$20. Anglers 12 to 15 years of age must still obtain a non-fee permit, and those anglers under the age of 12 may fish without a permit when accompanied by an adult with a permit. The revenue generated from the fishing fees remains in Yellowstone to support the park's fisheries program.

Regulations are generally species-specific, however, they vary from lake to lake, creek to creek, and river to river. Certain waters may be closed to protect rare or endangered species, nesting birds, or to provide vistas for viewing scenic landscapes and undisturbed wildlife. Some waters are catch-and-release fishing only while other areas have size limits and/or fish type or creel limits or gear restrictions (such as fly-fishing only). Bait fishing is strictly prohibited (except that children under 12 may fish with worms in some areas) and only fly fishing or lure fishing is allowed. Bait

fishing is prohibited in the park to prevent the introduction of non-native fish into park waters, to prevent overharvest, and because hooking mortality studies have shown an increased risk of death to fish caught with bait. Fishing is allowed only during certain seasons (usually late May through October).

In 1994, the National Park Service implemented a lead-free fishing program in Yellowstone. Fishing tackle such as leaded split-shot sinkers, weighted jigs, and soft weighted ribbon for nymph fishing are no longer permitted. This new policy was instituted in order to remove lead from the aquatic environment. Lead is known to cause poisoning in waterfowl when ingested.

### ***Fish Species Changes in Yellowstone Waters***

Because of the fish stocking activities that occurred in the park in its early years, native and non-native fish now live in waters that were once barren. In most cases, the non-native fish cannot be removed by any known or feasible method. Park policy today manages these fisheries while promoting native species recovery, where possible.

Historically, Yellowstone Lake was populated by only Yellowstone cutthroat trout and longnose dace. Today, these two species are still present, and the longnose sucker, lake chub, redbside shiner, and the illegally introduced lake trout also live in the lake's waters.

The Firehole River is famous for its world-class fishery. Historically, though, the river was fishless because of waterfalls blocking fish movement upstream. Today, anglers can fish for rainbow trout, brown trout, Yellowstone cutthroat trout, and brook trout in the thermally influenced stream.

Historically, the Madison and Gibbon rivers (below Gibbon Falls) were inhabited by westslope cutthroat trout, Arctic grayling, mountain whitefish, mottled sculpin, mountain sucker, and longnose dace. Today, those species survive (some in extremely depleted numbers) and brown trout, rainbow trout, and brook trout have been added to the mix.

When Heart Lake was first sampled for fish, Yellowstone cutthroat trout, mountain whitefish, speckled dace, redbside shiner, Utah sucker, Utah chub, and the mottled sculpin were found. Early fisheries managers added lake trout to Heart Lake.

Lewis and Shoshone lakes were historically fishless because of waterfalls on the Snake River. Today, the lakes support lake trout, brown trout, brook trout, Utah chub, and redbside shiner.

The lower Lamar River and Soda Butte Creek historically were home to Yellowstone cutthroat trout, longnose dace, longnose sucker, and mountain sucker. Today, those species survive, and rainbow trout was added to the drainage.

## Number in Yellowstone

## Reptiles and Amphibians

- Cool, dry conditions limit Yellowstone's reptiles to six species and amphibians to four species.
- Reptiles: prairie rattlesnake, bull snake, common garter snake, wandering garter snake, rubber boa, sagebrush lizard.
- Amphibians: boreal toad, chorus frog, spotted frog, tiger salamander.

## Status

- None listed as threatened or endangered.
- The spotted frog may be declining in the West.
- Some researchers suspect that there are more amphibians in Yellowstone than are currently known, but this has not been documented yet.

## Current Research

- In 1991, NPS staff began cooperating with Idaho State University to sample park habitats for reptiles and amphibians.

Visitors to Yellowstone often see the larger animals of the park—bison, elk, mule deer, moose and bears. But Yellowstone is also a home for many other animals, including a small variety of snakes and amphibians. There are six species of reptiles found in Yellowstone (prairie rattlesnake, bullsnake, common garter snake, wandering garter snake, rubber boa, and sagebrush lizard) and four species of amphibians (boreal toad, chorus frog, spotted frog, and tiger salamander). Cool and dry conditions are likely responsible for the relatively low number of reptiles and amphibians in Yellowstone.

In 1991 park staff began cooperating with researchers from Idaho State University to sample additional park habitats for reptiles and amphibians. This led to establishment of long-term monitoring sites in the park. The relatively undisturbed nature of the park and our baseline data may prove useful in testing hypotheses concerning the apparent declines of several species of toads and frogs in the western United States. Reptile and amphibian population declines may be caused by such factors as drought, pollution, disease, and/or predation.

Although there are no Yellowstone reptile or amphibian species currently listed as threatened or endangered, several—including the spotted frog—are thought to be declining in the West. Reptiles live on land and have scaly, dry skin. Amphibians have moist glandular skins, lack claws, and lay their eggs in water. The young must pass through a larval stage before changing into adults. Amphibious means “living a double life,” and salamanders, toads, and frogs indeed do that, living in water as larvae and near water for the rest of their lives.

## Wandering Garter Snake

The most common reptile in the park is the wandering garter snake. It is usually found near water in all areas of the park; it can range from 18 to 30 inches in length; and it may be brown, brownish green, or grey. It usually has a well-defined light stripe down its back. The garter snake eats fish, frogs, tadpoles, salamanders, earthworms, slugs, and leeches. When threatened, a garter snake may discharge musk from glands at the base of the tail, resulting in an unpleasant, sweet odor. These snakes give birth to as many as 20 live young during mid-summer.

## Bullsnake

Yellowstone's largest reptile is the bullsnake, ranging from 50 to 72 inches long. Bullsnakes prefer lower altitudes; drier, warmer climates; and open areas, which accounts for their being found mostly near Mammoth within the park. This yellowish snake is marked with a series of black,

brown, or reddish-brown blotches down the back; the darkest, most contrasting colors are near the head and tail. A bullsnake's head resembles a turtle's in shape, with a dark band extending from the top of the head through the eye to the lower jaw. The bullsnake is sometimes called a gopher snake because it lives in burrows and its favorite food is small rodents. When disturbed, a bullsnake will coil up, hiss loudly, and vibrate its tail against the ground, producing a "rattling" sound. This behavior causes people to think that it is a rattlesnake, and the bullsnake is often killed for this reason. This is unfortunate because these reptiles are especially effective in controlling rodents.

### ***Rubber Boa***

The rubber boa is the least common of all snakes in the park. It is one of two species of snakes in the United States that is related to tropical boa constrictors and pythons. Adult rubber boas reach a maximum of two feet in length. The snake's back is uniformly grey or greenish-brown, and its belly is lemon yellow. Its scales are small and smooth, making this snake almost velvety to the touch. The rubber boa is a secretive animal, and very little is known about its life history. It is believed that the snake spends a great deal of time partially buried under leaves and soil in heavily wooded areas around the Lower Geyser Basin. Rodents make up most of its diet.

### ***Prairie Rattlesnake***

The only venomous snake in the park is the prairie rattlesnake. It is found in the Reese Creek, Stephens Creek, and Rattlesnake Butte areas of northern Yellowstone where the habitat is drier and warmer than elsewhere in the park. It is a blotched rattlesnake that ranges from 35 to 45 inches in length. Colors may vary from greenish grey to olive green, greenish brown, light brown, or yellowish. The dark brown splotches down its back are bordered in white. This snake is supposed to live in harmony with rodents and burrowing owls, but these animals also make good meals for the snake.

### ***Blotched Tiger Salamander***

The only species of salamander known to live in Yellowstone is the blotched tiger salamander. Adults reach a maximum length of seven to eight inches. This salamander's head is broad and dark olive in color with irregular dark spots. The back and tail are black with olive-green to yellow-green blotches. The belly is a dull lemon yellow with irregular black spots. In Yellowstone, the salamander's distribution depends on the presence of adequate water and favorable temperatures between 60 and 75 degrees Fahrenheit; in the Lamar Valley, several sizable populations exist. In late April and early May, the adult salamanders come out from hibernation and migrate in large numbers to breeding ponds where they lay their eggs. They then return to their moist homes under rocks and logs.

Strictly carnivorous, salamanders feed on adult insects, insect nymphs and larvae, small aquatic invertebrates, and frogs, tadpoles, and small snakes. They are in turn preyed upon by snakes and some birds (like sandhill cranes). Commonly, these harmless creatures are found in cellars in the winter. Many people incorrectly believe they are poisonous and kill them needlessly.

### ***Boreal Toad***

Another of Yellowstone's amphibians is the boreal toad, the most common toad in the park. Adults reach a body length of 2-1/4 to 5 inches and are brown, grey, or olive green with irregular black spots. They always have a white or cream colored stripe down the back. Toads can easily be distinguished from frogs by their warty bodies, thick waists, and prominent glands behind their eyes. These toads can be found at elevations of more than 8,000 feet when water is adequate but are more often found at lower elevations. Though adults can tolerate dry conditions for some time, their eggs must be laid in water. As tadpoles, these animals eat aquatic plants. In contrast, the adult toad eats insects, worms, and small invertebrates. Toads are usually most active at night and can be commonly found throughout the park. A common misconception about toads is that handling them causes warts. A toad does secrete irritating fluids from glands on its back as a defense against predators, but this fluid does not affect the hands of people. Despite this protection, many toads are eaten by snakes and large wading birds.

### ***Spotted Frog***

Because of its size and abundance, the spotted frog is probably the best known amphibian in Yellowstone. It can be found all summer in cold rivers, streams, smaller lakes, marshes, ponds, and rain pools. Adults reach a maximum length of 3-1/2 inches. The upper surface of the body is greyish-brown to dark olive or even green with irregular black spots. The underside is white splashed with brilliant orange on the thighs and arms. (Young frogs do not usually show this.) Breeding begins in late spring or early summer depending on temperatures. The eggs are laid on the surface of the breeding ponds in compact jelly-like masses and hatch after a few weeks. The tadpoles mature and change into adults between July and September. Like toad tadpoles, spotted frog tadpoles feed strictly on aquatic plants, and the adults eat insects, aquatic invertebrates, and sometimes tadpoles. In the winter, the spotted frog, like all amphibians, burrows into moist mud that won't freeze and doesn't come up for air until spring. They can do this because they are able to absorb oxygen from the water directly through their skin.

### ***Western Chorus Frog***

The western chorus frog is another common amphibian in Yellowstone, but due to its small size and secretive habits, people rarely see it. The adults may range in size from 1 to 1-1/2 inches in length, and females are usually larger than males. Chorus frogs are small, slender creatures that are brown, olive, or green with a prominent black stripe from the nostril through the eye and over the arm. They also have three dark stripes down the back. These frogs may be found in grassy pools, lakes, and marshes. They usually breed in shallow temporary pools during the late spring. You can easily find them by following their calls, which resemble the sound of a thumb running along the teeth of a comb. The chorus frog lays its eggs in loose irregular clusters attached to submerged vegetation in quiet water. The eggs hatch in about two weeks, and the tiny tadpoles mature within 40 to 50 days. The chorus frog's food preferences are similar to the spotted frog's. Western spotted frogs, garter snakes, and wading birds are the chorus frog's natural enemies.

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